

Route 460 Location Study

Indirect and Cumulative

Technical Report



May 2005

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1.0 INTRODUCTION

The purpose of this technical report is to document the indirect and cumulative impact assessment methodology, process, and findings for the Route 460 Location Study. In compliance with the National Environmental Policy Act (NEPA) and the President's Council on Environmental Quality (CEQ) regulations (40 CFR 1508.25 (c)), the potential indirect impacts and cumulative impacts are examined along with the direct impacts of the 2026 No-Build Alternative, the TSM Alternative, and the CBAs. The purpose of the indirect and cumulative impact assessment is to ensure that federal actions consider the full range of potential environmental consequences. When assessing the indirect impacts and cumulative effects of a proposed action, it is important to effectively identify the potential consequences of human activities on the natural and built environment.

Direct, indirect, and cumulative impacts are assessed for this project in accordance with the following definitions provided in the Council on Environmental Quality (CEQ) regulations:

- Direct impacts are "caused by the action and occur at the same time and place" (40 CFR 1508.8);
- Indirect impacts are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable". Indirect effects are synonymous with secondary effects and "may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8); and
- Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR 1508.7).

The indirect and cumulative impact analysis for this project has been developed according to the guidance presented in the 1997 Council on Environmental Quality publication, *Considering Cumulative Effects*; the U.S. Environmental Protection Agency (USEPA) publication, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents* (May 1999); and the FHWA's 1992 Position Paper and 1996 handbook on *Community Impact Assessment*. Additional case studies, theoretical assumptions, and evaluation methods used in this analysis are referenced within the applicable sections of this technical report.

This report addresses potential indirect and cumulative environmental consequences of the No-Build, TSM, and Candidate Build Alternatives (CBAs). For the CBAs, impact areas were determined based on two corridor widths:

- A 500-foot wide "Planning Corridor"; and
- A narrower "Design Corridor" estimated from the typical roadway section and proposed construction limits.

The Design Corridor is 230 feet wide for CBAs 1, 3, and the sections of CBA 2 on new location. For sections of CBA 2 along the existing Route 460 alignment, the proposed Design Corridor is 140 feet wide. Both corridor widths increase at proposed interchanges (CBAs 1, 2, and 3) and at-grade intersections (CBA 2) to provide necessary access to cross streets and highways.

Impact analyses relied on methods and assumptions detailed throughout this report and in the associated technical reports referenced. For resources that involve direct, quantitative measurements, impact estimates are provided for both the Planning Corridor and Design Corridor. The greater width of the Planning Corridor provides flexibility to further reduce or avoid impacts during final design. The impacts identified for the Design Corridor provide a more realistic example of the anticipated project impacts for each CBA. For resource impacts that are stated qualitatively, impacts are presented for the Design Corridor CBAs only.

2.0 AFFECTED ENVIRONMENT

The indirect and cumulative impact assessment for the Route 460 study area was evaluated from a baseline of present and/or planned conditions. A brief summary of the affected environment is provided in the following sections. Detailed descriptions of the existing and future affected environment, as well as direct impacts to the human and natural environment, are provided in the following technical reports and are incorporated by reference:

- Land Use, Parklands and Farmlands Technical Report;
- Socioeconomic Technical Report;
- Water Quality Technical Report;
- Natural Resources Technical Report;
- Right-of-Way and Relocation Technical Report;
- Traffic, Transportation and Freight Technical Report.

2.1 POPULATION AND EMPLOYMENT

Table 2.1-1 illustrates the population trends for jurisdictions in the study area. Isle of Wight County and the City of Suffolk have grown at a faster rate than the Commonwealth over the past three decades, while Southampton County has had an overall population loss. Of the communities along Route 460 in the study area, Kings Fork, Waverly, and Windsor have experienced population gains since 1990. Jurisdictional level data from the Bureau of Economic Analysis (BEA) provides a comparison between the Commonwealth of Virginia and the study area jurisdictions (Table 2.1-2). All of the study area jurisdictions have had slower employment growth rates than the Commonwealth in the past three decades.

Table 2.1-1
POPULATION TRENDS FOR THE STUDY AREA JURISDICTIONS

Jurisdiction	1970	1980	1990	2000	Average Annual Compound Rate 1970-2000	Total Percent Change 1970-2000	Total Population Change 1970-2000
Virginia	4,648,494	5,346,818	6,187,358	7,078,515	1.4%	52.3%	2,430,021
Isle of Wight County	18,285	21,603	25,053	29,728	1.6%	62.6%	11,443
Prince George County	29,092	25,733	27,394	33,047	0.4%	13.6%	3,955
Southampton County	18,582	18,731	17,550	17,482	-0.2%	-5.9%	(1,100)
Surry County	5,882	6,046	6,145	6,829	0.5%	16.1%	947
Sussex County	11,464	10,874	10,248	12,504	0.3%	9.1%	1,040
City of Suffolk ¹	9,858	47,621	52,141	63,677	6.2%	545.9%	53,819

¹ City of Suffolk merged with Nansemond County in 1974
Source: US Census Bureau, Census 1970 – 2000

Table 2.1-2
EMPLOYMENT TRENDS FOR STUDY AREA JURISDICTIONS

Employment Trends	1970	1980	1990	2000	Average Annual Compound Growth Rate 1970-2000	Total Percent Change 1970-2000	Total Employment Change 1970-2000
Virginia	2,157,657	2,801,662	3,726,176	4,407,324	2.3%	104.3%	2,249,667
Isle of Wight County	9,299	11,879	12,128	16,034	1.8%	72.4%	6,735
Prince George County ¹	26,075	28,133	27,701	28,901	0.3%	10.8%	2,826
Southampton County ²	9,521	10,018	10,146	11,586	0.6%	21.7%	2,065
Surry County	3,662	3,073	3,193	2,604	-1.1%	-28.9%	(1,058)
Sussex County	4,129	3,385	3,846	4,886	0.5%	18.3%	757
City of Suffolk	18,050	19,689	20,639	26,007	1.2%	44.1%	7,957

¹ Prince George County totals include employment in Prince George County and the City of Hopewell

²Southampton County totals include employment in Southampton County and the City of Franklin

Source: U.S. Bureau of Economic Analysis, 2004

2.2 LAND USE CHARACTERISTICS AND PLANNING

To determine indirect and cumulative impacts, it is essential to understand the existing and planned land use conditions, issues, goals, and objectives for each locality affected by the proposed project. To that end, this information has been summarized, by locality, based on each locality's most current land use plan and on individual meetings with the planning staff from each locality.

2.2.1 Prince George County

During the 1990s, Prince George County experienced higher than expected population growth. This resulted in residential, commercial, and industrial development predominantly in areas southwest of Hopewell and to the south and east of Petersburg. The county provides water and sewer services to major growth areas within the county, including the Route 460 industrial corridor to the east of I-295. The largest commercial and industrial establishments have concentrated along the U.S. Route 460 corridor, west of Route 156. This is consistent with county's designation of Opportunity Districts primarily along the Route 460 corridor. These districts are areas targeted for either intensive commercial or industrial development.

As noted in the county's Comprehensive Plan Update, the Route 460 corridor is located within both the County's Prince George and Warwick Planning Areas; the areas the county expects to experience the majority of the county's future development pressures. The Prince George Planning Area contains the majority of the residential, commercial, and industrial land uses within the county. During the 1990s, the majority of suburban growth experienced by the county occurred in this planning area. Within this planning area, the county designated an Opportunity Zone that provides special incentives to industries that locate within the zone. This Opportunity Zone encompasses an area of approximately six square miles around the I-295 and Route 460 interchange.

The Warwick Planning Area also experienced a substantial amount of primarily residential development in the 1990s. The community of Disputanta, located within this planning area, experienced commercial growth along Route 460 prior to the 1960s.

2.2.2 Sussex County

Sussex County's major land use and industry is agriculture. One of the county's major concerns is a failure to attract new industry caused, in part, by an inadequate east-west transportation route (e.g., existing Route 460). Within Sussex County, the Route 460 corridor includes four Planning Areas: Black Swamp, Waverly, General Mahone Highway (Route 460), and Wakefield / Birch Island Road. Along the Route 460 corridor, the current land use is dominated by Forested / Agricultural / Open Space with Rural Residential development along the secondary roads adjacent to Route 460. The county's future land use plan indicates that residential development will either be concentrated in planned communities (subdivisions) or located as strip development (1 acre minimum lots) along highways in order to preserve the agricultural and timber economy of the county.

Along the Route 460 corridor, the county's limited commercial and industrial development is primarily located within the Wakefield and Waverly areas. In Sussex County, much of the Route 460 corridor's future land use is planned for industrial development within a half mile of either side of the road. Given the shortage of vacant land within the county's towns, residential growth beyond the town limits is anticipated, including Waverly and Wakefield. Of the county's various planning areas, the four noted above, all along Route 460, are planning areas where major growth is encouraged. The county is looking to develop employment and commercial centers, as well as develop residential areas. Through its future land use plan, the county is encouraging the separation of major growth areas (such as Waverly and Wakefield) from rural areas to protect and preserve the county's rural character.

2.2.3 Surry County

Surry County's Land Development Plan notes that the economic base of the county is agricultural production. Commercial woodland is by far the dominant land use within the county, followed by agricultural lands. The primary commercial land uses are located in the Towns of Surry and Claremont with some highway-oriented trade scattered along Routes 10, 31, and 40. The county's primary industry, the Surry nuclear power station, is located in the Town of Surry. Route 31 is the main route within the county and the county encourages future business and industrial development along this route. The county has developed the Surry Industrial Park which opened in 2004. The Town of Dendron is adding water and sewer service in 2005. This service will allow for growth in Dendron, which could lead to rezoning.

2.2.4 Southampton County

Over 90 percent of Southampton County is in agricultural and forest use with less than five percent each attributable to residential and commercial/industrial uses. Most residential development is concentrated in towns and village centers, land adjacent to the City of Franklin, and as strip development along the county's roads and highways. Recent new residential development is focused in the eastern portion of the county, near Franklin. Due to a shortage of vacant land available within towns, residential growth beyond towns' incorporated limits is anticipated. This includes the Town of Ivor, along Route 460. Concentrated residential development will occur adjacent to Franklin or the towns where public water and sewer utilities are available, or in adjacent areas where this infrastructure can be extended.

Based on the County's comprehensive plan, future land use to the west of Ivor and out to the Sussex county line is planned to be commercial and industrial development. Future land use to the east of Ivor is planned to be small commercial development near Ivor, then residential development primarily to the north, east, and southeast of Ivor.

To help ensure the preservation of Southampton's rural character and discourage densely developed residential areas designated for agriculture, the county encourages large lot, rural residential subdivisions for single-family residential development.

2.2.5 Isle of Wight County

Existing major industrial land uses are currently located in four general areas of the County: the meat packing plants located in Smithfield, the International Paper mill east of Franklin, and agricultural operations in Windsor and Zuni along the Route 460 corridor. The county has three strategically located Development Service Districts (DSDs): Newport, Route 460/Windsor, and Camptown Districts. The county determined that these are the most suitable locations for future growth and development. Within much of the Route 460/Windsor DSD, water and sewer facilities have been extended to accommodate growth with most of the land surrounding Windsor designated as a Town Growth Area. The town's new sewer facility currently serves 785 existing residential and commercial uses and can accommodate another 600 acres of residential, commercial, and industrial growth. Future areas designated for commercial and industrial development are to be large (e.g., 10 to 15 acres) and to be located at intersections providing site frontage. The Shirley T. Holland Commerce Park, located east of Windsor, is one such recently established business development. In addition, areas along the Route 460 corridor and Norfolk and Southern rail line have strong potential for future industrial development due to the availability of some of the largest tracts of developable land on the East Coast with both rail and highway access. In general, commercial and industrial land uses are located along and south of Route 460 in Windsor, while residential uses are located north of Route 460 in Windsor.

Isle of Wight's comprehensive plan calls for keeping Village Centers such as Zuni small in population and physical area to maintain a unique sense of place. Zuni is a farming community with excellent surrounding farmland based primarily on the peanut market. However, county plans call for focused development rather than strip development along Route 460. Zuni has limited localized commercial services and employment opportunities. In an effort to maintain Zuni as a farming community, the county plans do not call for central water and sewer outside the immediate vicinity of Zuni.

2.2.6 City of Suffolk

Suffolk sits at an important regional crossroads in southeastern Virginia; traffic drawn from I-95 and from North Carolina to Hampton Roads travels through Suffolk via Routes 460 and 58 from the west and Route 13 from the south. The portion of the City of Suffolk within the study area is designated as a Rural Conservation Area / Low Intensity Residential (with public water) area. However, the city's future land use plan indicates this area will change to Rural Residential (future up-zoning) north of Route 460 and to Suburban / Urban on the eastern portion of Route 460 that connects to the Route 58 Bypass. The city's comprehensive plan indicates that development to the northwest of the city, including the area along the Route 460 corridor, will be substantially lower in intensity, with an emphasis on larger lot homes with public water and septic systems. This low intensity development near the area of downtown Suffolk will help reduce the potential for intensive development along major transportation corridors (such as Route 460). Employment will be focused in the urbanized areas. Land use in the vicinity of highway interchanges will be preserved for future economic development, primarily non-retail (e.g., business office park).

2.3 SURFACE WATER RESOURCES AND AQUATIC HABITAT

The study area covers four major watersheds. The Blackwater River watershed is 474,990 acres in total size and 308,786 acres cover 65 percent of the study area. The Lower James River watershed is 920,390 acres in total size, with 93,767 acres covering 20 percent of the study area. The Hampton Roads watershed (Nansemond River watershed) is 304,494 acres and 64,536 acres cover 14 percent of the study area. The Nottoway River watershed is 1,096,209 acres in total size, with 10,289 acres covering two percent of the study area.

The study area contains perennial streams and a large number of named and unnamed intermittent streams. Of these, the Blackwater River is the most prominent and longest stream course. The major surface water impoundments of Lake Burnt Mills, Western Branch Reservoir, Lake Prince, Lake Cahoon, and Lake Meade are located in the easternmost portion of the study area. Lake Prince and the Western Branch Reservoir serve as part of the public water supply for the City of Norfolk and the Lake Kilby and the Lake Meade for the City of Portsmouth. In general, overall species richness is highest within aquatic habitat and associated riparian zones, intermediate in upland forests and lowest in agricultural lands and developed areas. (Virginia Department of Game and Inland Fisheries, 2005)

2.4 TERRESTRIAL COMMUNITIES AND HABITAT

Most of the forestlands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, by residential and commercial development. Due to a long history of agricultural and silvicultural activities, most uplands within the region are so highly fragmented that they afford limited contribution with respect to wildlife corridors. Riparian corridors, on the other hand, have been less altered over history and presently serve as components of several prominent wildlife corridors within the study area. In all cases, these prominent wildlife corridors are associated with contiguous forest communities.

3.0 INDIRECT LAND USE IMPACTS

3.1 ASSUMPTIONS

This report addresses potential indirect and cumulative environmental consequences of the No-Build, TSM, and Candidate Build Alternatives (CBAs). For the CBAs, impact areas were determined based on two corridor widths:

- A 500-foot wide "Planning Corridor"; and
- A narrower "Design Corridor" estimated from the typical roadway section and proposed construction limits.

The Design Corridor is 230 feet wide for CBAs 1, 3, and the sections of CBA 2 on new location. For sections of CBA 2 along the existing Route 460 alignment, the proposed Design Corridor is 140 feet wide. Both corridor widths increase at proposed interchanges (CBAs 1, 2, and 3) and at-grade intersections (CBA 2) to provide necessary access to cross streets and highways.

A review of regional, state, and national studies was completed to identify the empirical and qualitative relationships between roadway improvements, interchange construction, and land use changes. It is assumed that land use changes have the potential to occur as a result of changes in physical access and travel-time savings. Interviews were held with local officials and planners to discuss potential land use changes.

Because the TSM Alternative would result in the same projected traffic volumes as the No-Build Alternative, it is assumed that the indirect land use impacts for the No-Build and TSM Alternatives would be the same. In addition, no distinction has been made between the indirect land use impacts associated with the Design Corridor or Planning Corridor CBAs because they provide the same levels and locations of accessibility, as well as the same travel time benefits.

Comprehensive land use plans and zoning provided by the localities were used to develop the land use conditions anticipated in the No-Build, TSM, and Build Conditions. For the CBAs, the differences in level of planning data and resources among the localities necessitated an independent analysis of growth potential in interchange areas to assure consistency. These findings were discussed with local planners, and the indirect land use findings are based primarily on the land use conditions and development factors described by local officials. Based on these discussions, impacts were assessed for each of the CBA interchange areas. A zone of potential influence having a one-mile radius (2,000 acres) around each interchange was considered for indirect land use impacts. In this analysis, this area is referred to as the interchange area, which is synonymous with CEQ's project impact zone. The potential for sprawl development outside of interchange areas is also analyzed as an indirect land use impact, based on the local planning information as well as travel time and commuting data.

Based on the rural nature of this area and local areas' varying expectations for growth, not all interchange areas are anticipated to have indirect land use changes. This analysis evaluates the interrelationship of external development factors and the influence of the CBAs at each interchange area to determine the potential locations for indirect land use impacts. CBAs 1 and 3 provide nine new interchange locations, whereas CBA 2 provides eight new interchange locations and eleven at-grade intersection locations. To examine the indirect effects of land use changes, it was assumed that the scale of the induced development would be similar in magnitude to existing and planned development within the study area. For example, the acreage of existing gas stations / convenience stores along Route 460 ranged in size from two to six acres; therefore, new gas stations / convenience stores were assumed to require an average of four acres. It was assumed that where adequate developable land was available, existing agricultural and forestland uses would absorb new development. During this process, when other factors

were equal, it was also assumed that agricultural uses were slightly more attractive as potential development locations than forestland uses.

3.2 EVALUATION METHODS

As current research suggests, accessibility is the key factor in assessing the potential impact of a transportation project on land use. When a transportation project makes it easier to access certain locations, “these places become more attractive to more or different types of development. However, improving accessibility does not guarantee that land use change will follow.” (*Land Use Impacts of Transportation: A Guidebook*, 1999) The CBAs will affect accessibility by physically changing access (i.e. providing new interchange and intersection locations) and lowering travel times between Petersburg and Suffolk.

Because counties and incorporated areas have jurisdiction over land use, the land use plans and regulations and the economic development plans of localities were the primary basis for determining the future land use for the No-Build/TSM and CBA alternatives. However, local plans were not prepared with the CBAs in mind; therefore, analysis was conducted to estimate likely levels of interchange development, taking into account the local context and the results of interviews with local officials. The findings were reviewed by local jurisdictions. The application of an empirically-based framework for interchange area development, as discussed below, lends consistency and objectivity to the indirect land use impact analysis, while local coordination maintains the focus of the analysis on the local jurisdiction decision-making process.

To determine the potential for land use changes at each potential impact zone, a tool based on the Hartgen model was used in this analysis (Hartgen, 1992). The Hartgen model correlates development factors to estimate the potential level for development at rural interchanges on limited access highways. This model, coupled with information provided by local officials, was used to identify potential land use changes attributable to the CBAs.

Table 3.2-1 highlights the typical sequence or stages of development at an interchange that are likely within the interchange areas, based on Hartgen’s model and information from the localities. As noted in Hartgen’s model, the likelihood of an interchange or intersection area experiencing induced growth or changes in land use is based on a number of factors, including:

1. Traffic volumes on the proposed alternative and crossroad;
2. Population of the nearest and surrounding communities;
3. Distance to major urban centers;
4. Distance between interchanges;
5. Current land use; and
6. Site factors at the interchange or intersection (availability of water and sewer, planned land uses, local land use policies, visibility, environmental constraints).

Based on these factors, it is possible to determine the likely type of development that can be anticipated at each interchange area. For those interchange areas projected to alter future development patterns, a GIS review of existing land uses and comprehensive land use planning within each interchange area identified the amount of developable land available to absorb the anticipated development. The potential acreage of induced development was hand-allocated to the appropriate interchange area. Due to the lack of detailed land use plans and zoning (such as density guidelines) in some parts of the corridor, precise comparisons of future No Build and future Build land use are not possible in all of the interchange areas. Acres of induced development were projected based on existing land use densities.

The likelihood of impacts to sensitive resources from induced development was assessed based on the amount of land consumed by new development relative to the amount of available, developable land in the interchange areas. Agricultural land is assumed to be the most attractive land for development

relative to forested land uses. Properties least likely for development include locally or federally protected lands in agricultural and forestal districts and waters of the U.S. (e.g. jurisdictional wetlands). Areas where land use is not anticipated to change but may have indirect impacts in the form of development timing are also identified.

Table 3.2-1
TYPICAL STAGES IN INTERCHANGE DEVELOPMENT

STAGES	DEVELOPMENT ANTICIPATED	REQUIREMENTS
Minimal Development	<ul style="list-style-type: none"> Land use will remain in forested, agricultural, or rural residential. 	<ul style="list-style-type: none"> No requirements
Residential	<ul style="list-style-type: none"> Single family homes on medium sized lots (one-acre or less) Area of induced development based on comparable existing and planned developments 	<ul style="list-style-type: none"> ADT on crossroad < 2,000 Existing land use: undeveloped or residential Site factors: not planned for commercial or industrial uses Travel time savings to closest urbanized area
Light Tourist / Commercial Services	<ul style="list-style-type: none"> 1+ gas station 1 fast food restaurant 10 acres of induced development assumed 	<ul style="list-style-type: none"> ADT on crossroad > 4,000 Within 10 miles of town Water is available Not currently planned and approved for residential use
Economically Competitive	<ul style="list-style-type: none"> 2-4 gas stations 1-2 fast food restaurants 20 acres of induced development assumed 	<ul style="list-style-type: none"> ADT on crossroad > 8,000 Within 3 miles of town Distance to the next interchange > 5 miles Water and sewer are available
Other Development	<ul style="list-style-type: none"> Includes industrial, business, or medical park development. Varies according to local land use and economic development plans. Planned development would not be induced by the proposed project, but it may affect the timing or size of the planned development 	<ul style="list-style-type: none"> Existing industrial or business development Planned and approved industrial or business development by locality Travel time savings to closest urbanized area

Sources: Hartgen, 1992 and Michael Baker Jr., 2004.

3.3 INDIRECT LAND USE CHANGES

As previously noted, acreage of induced development was estimated and allocated to available land based on the assumption that accessible, agricultural land would develop first, followed by accessible forested non-wetland acres. In every case, these two land types were more than sufficient to absorb the projected development. These results were discussed with the appropriate localities to confirm the validity of the analysis.

Detailed descriptions of the interchange locations with indirect land use impacts compared to the No-Build and TSM 2026 conditions are provided in Table 15.4-1 through Table 15.4-3 for CBAs 1, 2, and 3, respectively. (Because these tables are lengthy, they appear at the end of this document in Supporting Tables.) A discussion of the likely land use changes, by alternative, is provided in Sections 3.3.1 and 3.3.2 that follow.

3.3.1 2026 No-Build and TSM Alternatives

Changes in planned land use are not expected under either the 2026 No-Build or the TSM Alternative. It is assumed that approved projects and land uses will develop as planned. However, the increasing travel-time delays could hinder the planned economic development along the Route 460 corridor. Travel times from Petersburg to Suffolk are anticipated to increase by 8 minutes (11 percent) between 2000 and 2026 (see Table 15.4-4 and Section 5.4.2 for a discussion of travel time savings).

3.3.2 Candidate Build Alternatives

As summarized in Table 3.3-1 and shown in Figure 3.3-1 through Figure 3.3-3, all CBAs have the potential to induce land use changes when compared to the 2026 No-Build and TSM Alternatives. The potential for induced development and associated land use changes would occur as follows:

- CBA 1 - Of the nine interchange locations, four have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 156 in Prince George County, Route 40 in Waverly, Route 620 in Wakefield, and Route 58 bypass in Suffolk for a total of 340 acres.
- CBA 2 - Of the 19 interchange and intersection locations, four have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 40 in Waverly, Route 620 in Ivor, Route 460 at the Isle of Wight/Suffolk line, and Route 58 bypass in Suffolk for a total of 50 acres.
- CBA 3 - Of the nine interchange locations, seven have the potential for induced development. These land use changes are anticipated to occur in the interchange area at Route 156 in Prince George County, Route 40 in Waverly, Route 31 in Wakefield, Route 620 in Ivor, Route 258 in Windsor, Route 460 at the Isle of Wight/Suffolk line, and Route 58 bypass in Suffolk for a total of 380 acres.

Overall, the likelihood for induced land use changes would be greatest under CBAs 1 and 3 and, somewhat lesser under, CBA 2. Different types and scales of induced development are discussed in the following paragraphs.

Table 3.3-1
SUMMARY OF POTENTIAL LAND USE CHANGES BY ALTERNATIVE COMPARED TO 2026 NO-BUILD AND TSM ALTERNATIVES

Intersection or Interchange Location ¹	No-Build/TSM (Existing and Planned Land Uses)	CBA 1	CBA 2	CBA 3
		Land use changes compared to No-Build /TSM		
I-295 and Route 629/630 (New Bohemia)	Existing and planned developments include Southpoint Industrial Park (1,800 acres) and Norfolk Southern's Petersburg Intermodal Facility (217 acres)	⊙	⊙	⊙
Route 156 1.7 miles south of Route 460 (Prince George Co)	Existing rural residential (Charleston Estates) Planned for rural/agricultural uses	Residential 300 Acres	---	---
Route 156 2.3 miles north of Route 460 (Prince George)	Existing and planned rural residential/agricultural uses	---	---	Residential 300 acres
Route 460 west of Disputanta	Existing rural residential and commercial uses Planned for commercial and industrial uses	---	○	---
Route 625 1.5 miles south of Route 460 (Disputanta)	Existing and planned rural/agricultural uses 500 acre subdivision with five-acre lots planned (Arwood Road) Warwick Acres (24 units with 3 acre lots under construction)	○	---	---
Route 625 0.5 miles north of Route 460 (Disputanta)	Existing and planned residential and commercial uses	---	⊙	---
Route 625 3.3 miles north of Route 460 (Disputanta)	Existing and planned rural/agricultural uses 12 lot subdivision with 5 acre lots approved (Lebanon Forest) Pleasant Grove Estates planned north of interchange area	---	---	○
Route 460 east of Disputanta	Existing rural residential and commercial uses Planned for commercial uses	---	○	---
Route 602 (Sussex County)	Existing industrial uses (Atlantic Waste and Industrial) Planned for industrial expansion - power Plant under consideration	○	---	---

Notes: Table summary continued on following page

Interchange areas considered in this analysis cover a one-mile radius (2,000 acres) and is also called the potential impact zone.

¹ Distance provided is between Route 460 and center of the proposed interchange

○ No change in planned land use

⊙ No change in type and scale of planned land use compared to No Build/TSM, but alternative may increase the rate and timing of development

--- Indicates that the CBA did not provide new access at that location

Intersection or Interchange Location ¹	No-Build/TSM (Existing and Planned Land Uses)	CBA 1	CBA 2	CBA 3
		Induced land use change compared to No-Build /TSM		
Route 460 west of Waverly	Existing agricultural/forest uses Planned for industrial uses - Regional Industrial Park (171 acres) planned at old Waverly Airport	---	○	---
Route 40 1.6 miles south of Route 460 (Waverly)	Existing and planned residential and industrial uses Waverly Meadows (70 lots) approved	Light Tourist/ Commercial 10 Acres	---	---
Route 40 1.2 miles north of Route 460 (Waverly)	Existing and planned residential and commercial uses	---	Light Tourist/ Commercial 10 Acres	Light Tourist/ Commercial 10 Acres
Route 460 east of Waverly	Existing and planned commercial uses	---	○	---
Route 460 west of Wakefield	Existing rural residential and commercial uses Planned industrial uses near Wakefield Airport	---	○	---
Route 620 2.9 miles south of Route 460 (Wakefield)	Existing and planned residential and agricultural uses Drumwright Mill subdivision (500-lots) approved	Light Tourist/ Commercial 10 Acres	---	---
Route 31 1.3 miles north of Route 460 (Wakefield)	Existing and planned residential uses	---	⊙	Light Tourist/ Commercial 10 Acres
Route 460 east of Wakefield	Existing residential uses Planned commercial uses	---	○	---
Route 460 west of Ivor	Existing residential and industrial uses Planned for commercial uses	---	○	---
Route 616 2.3 miles south of Route 460 (Ivor)	Existing and planned rural residential/agricultural uses	⊙	---	---
Route 620 0.9 miles north of Route 460 (Ivor)	Existing and planned residential and commercial uses	---	Light Tourist/ Commercial 10 Acres	---
Route 620 2.5 miles north of Route 460 (Ivor)	Existing and planned rural residential/agricultural uses	---	---	Light Tourist/ Commercial 10 Acres

Notes: Interchange areas considered in this analysis cover a one-mile radius (2,000 acres) and is also called the potential impact zone.

¹ Distance provided is between Route 460 and center of the proposed interchange

○ No change in planned land use

⊙ No change in type and scale of planned land use compared to No Build/TSM, but alternative may increase the rate and timing of development

--- Indicates that the CBA did not provide new access at that location

Intersection or Interchange Location ¹	No-Build/TSM (Existing and Planned Land Uses)	CBA 1	CBA 2	CBA 3
		Induced land use change compared to No-Build /TSM		
Route 460 east of Ivor	Existing and planned residential and commercial uses	---	○	---
Route 460 west of Zuni	Existing rural residential / agricultural uses Planned commercial in Southampton County Planned Resource Conservation Area (Blackwater River and associated wetlands) in Isle of Wight County	---	○	---
Route 460 east of Zuni	Zuni is an existing Village Center Planned as a Rural / Agricultural Conservation District.	---	○	---
Route 460 west of Windsor	Existing residential and commercial uses Planned light industrial / business park use to the south of Route 460, near Route 258	---	○	---
Route 258 0.5 miles south of Route 460 (Windsor)	Existing and planned residential, commercial, and industrial uses	⊙	---	---
Route 258 0.8 miles north of Route 460 (Windsor)	Existing residential and commercial uses Expansion of Windsor Woods subdivision approved (52 lots)	---	○	---
Route 258 1.5 miles north of Route 460 (Windsor)	Existing residential uses Expansion of Windsor Woods subdivision approved (52 lots)	---	---	Economically Competitive Commercial 20 Acres
Route 460 west of Windsor (Isle of Wight/Suffolk Line)	Existing commercial and agricultural uses Planned residential (Suburban Estate) uses Isle of Wight Co. Planned Conservation Development in Suffolk	---	Light Tourist/ Commercial 10 Acres	Light Tourist/ Commercial 10 Acres
Route 58 Bypass (Suffolk)	Existing residential and interchange related commercial uses Planned for suburban/urban and office park development	Economically Competitive Commercial 20 Acres	Economically Competitive Commercial 20 Acres	Economically Competitive Commercial 20 Acres

Notes: Interchange areas considered in this analysis cover a one-mile radius (2,000 acres) and is also called the potential impact zone.

¹ Distance provided is between Route 460 and center of the proposed interchange

○ No change in planned land use

⊙ No change in type and scale of planned land use compared to No Build/TSM, but alternative may increase the rate and timing of development

--- Indicates that the CBA did not provide new access at that location

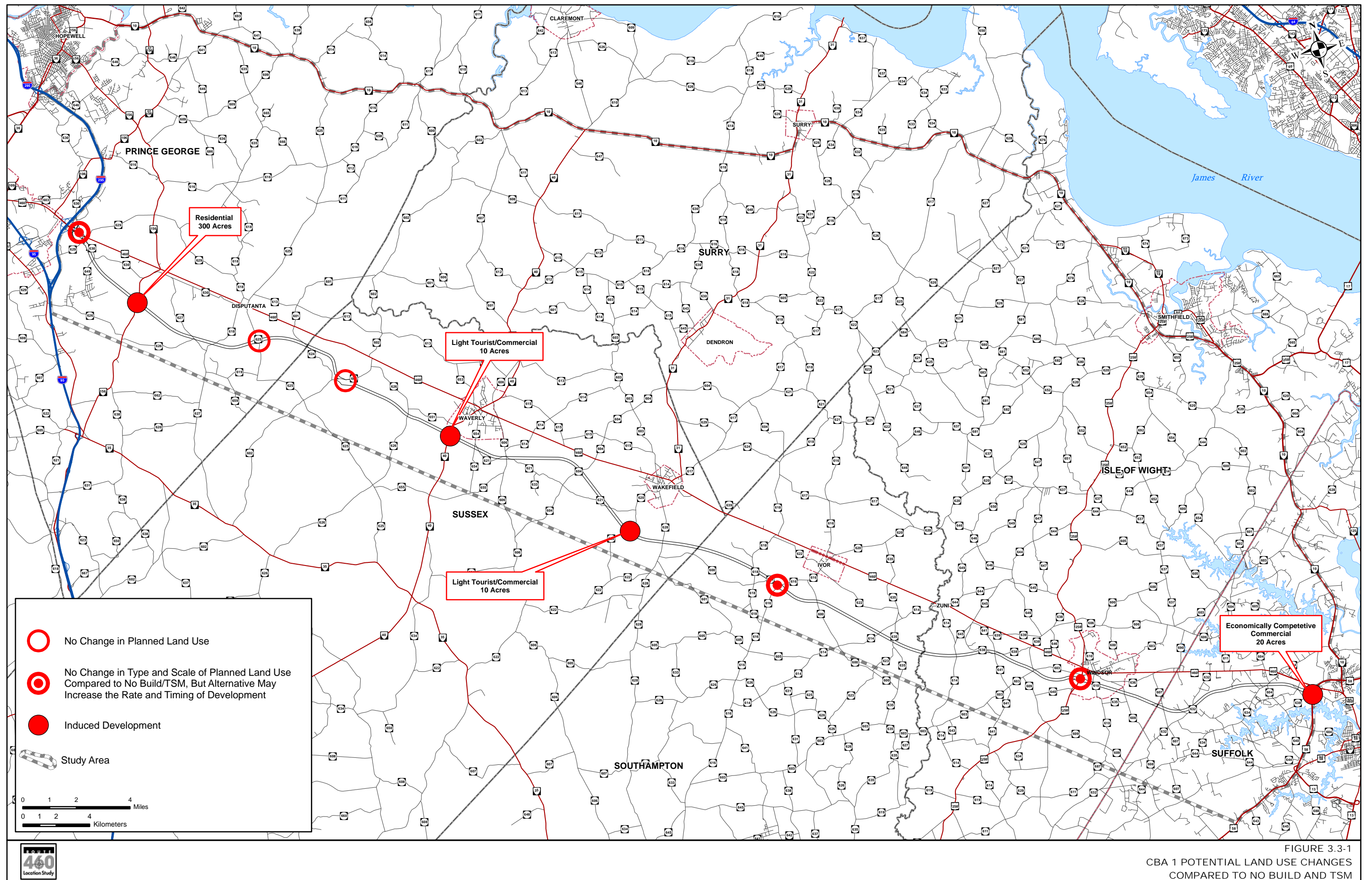


FIGURE 3.3-1
CBA 1 POTENTIAL LAND USE CHANGES
COMPARED TO NO BUILD AND TSM

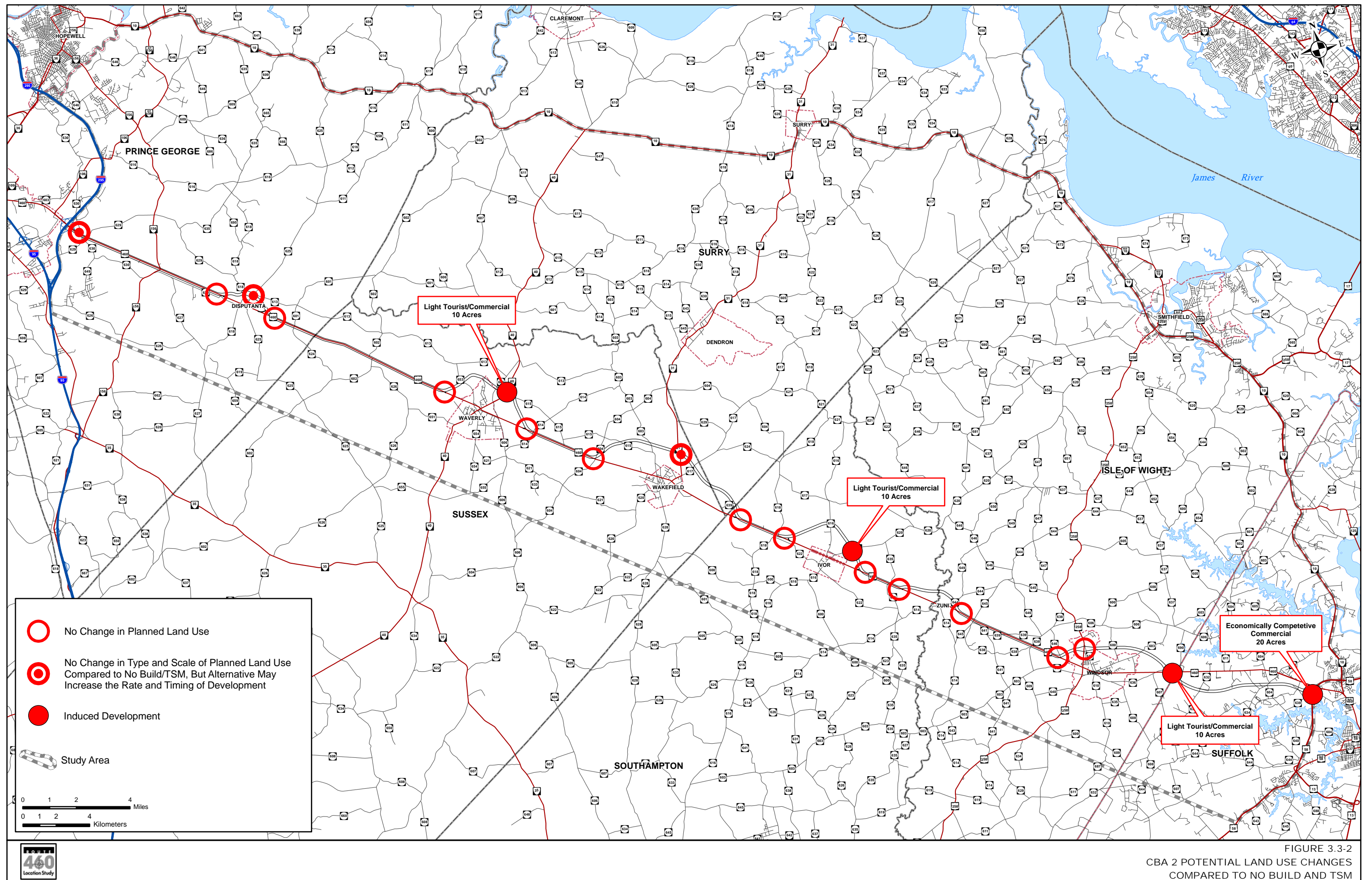


FIGURE 3.3-2
CBA 2 POTENTIAL LAND USE CHANGES
COMPARED TO NO BUILD AND TSM

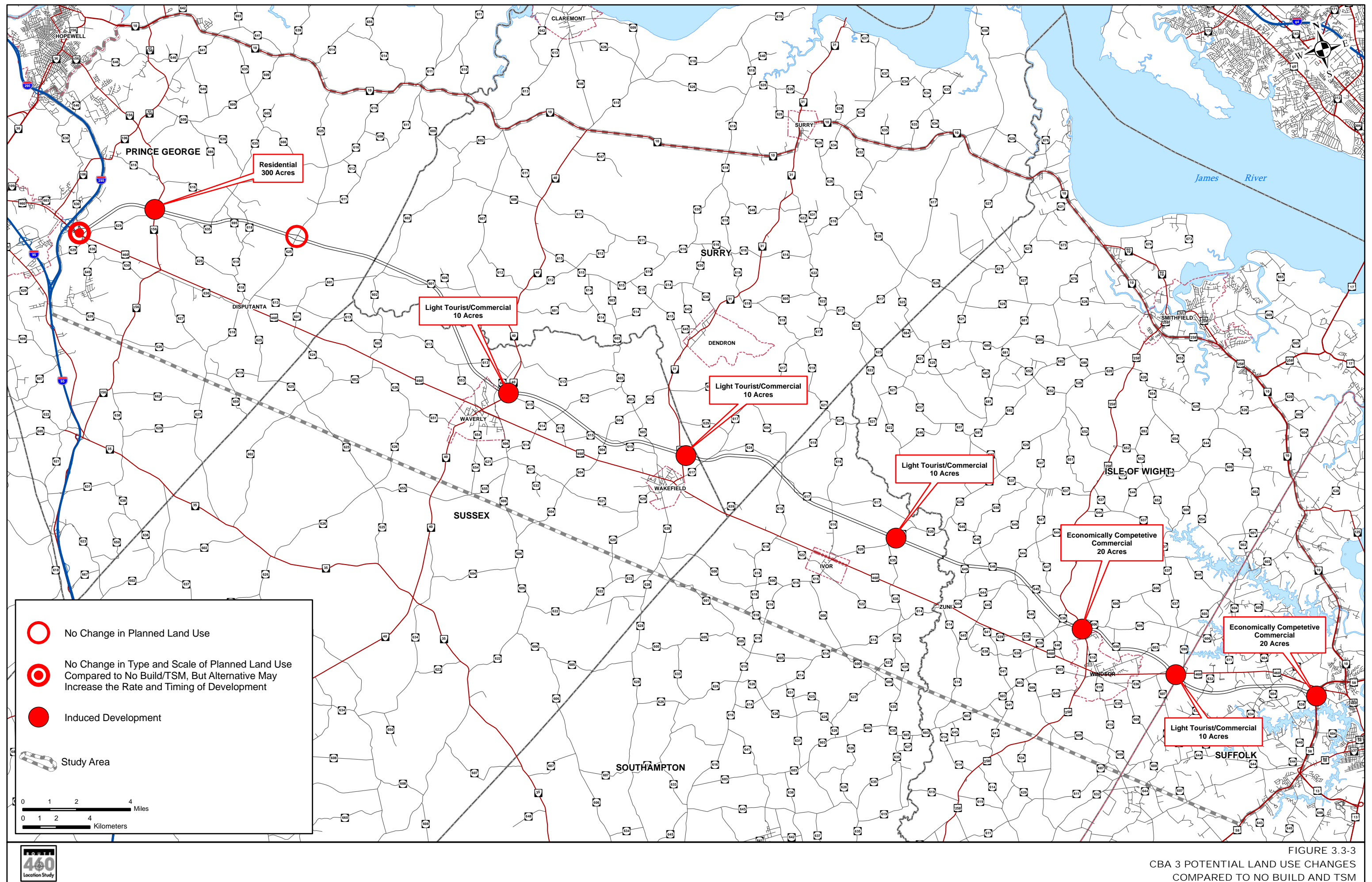


FIGURE 3.3-3
CBA 3 POTENTIAL LAND USE CHANGES
COMPARED TO NO BUILD AND TSM

Based on discussions with local planners and application of the criteria presented in Table 3.2-1, CBA 1 and 3 are both anticipated to result in 300 acres of induced residential development in Prince George County at the Route 156 interchange area. This land use change is based on the following factors: traffic volumes on Route 156 exceed 2,000 ADT, existing land uses are residential but include adequate developable land, the area is zoned for residential uses, and the CBAs would provide direct access and travel time savings to Petersburg and Hopewell via I-295. Local planners indicated that new residential development associated with the CBAs would be similar in size and scale to currently planned residential development. An increasing rate of conversion of land to residential uses may also occur beyond these interchange locations and would likely be the cumulative result of regional population growth, market trends, and travel time savings. The potential for sprawl development patterns as an additional indirect impact is discussed at the end of this section.

CBAs 1 and 3 would also result in 10 acres of induced commercial development in the communities of Waverly and Wakefield. This development is anticipated to include travel-oriented businesses such as a gas station, convenience store, or a fast-food restaurant. At these locations, water and sewer are either available or localities indicated they would be made available. In addition, the traffic volumes on Route 40 and Route 31 are high enough to generate economic activity around the interchange area. A similar level of induced commercial development is anticipated with CBA 2 in Waverly and CBAs 2 and 3 in Ivor and at the Isle of Wight/Suffolk City line.

All CBAs have the potential to induce 20 acres of “economically competitive” development at the Route 58 bypass in Suffolk, as well as in Windsor with CBA 3. Economically competitive development, as defined by the model, would include two to four gas stations and one to two fast food restaurants or services on a similar scale. This prediction is supported by the local planners.

In the case of CBA 2, at the western and eastern bypass termini intersections, the communities along existing Route 460 are not projected to experience a change in the rate or scale of planned development, nor are they likely to experience a change in the type of planned land use. This is based on several factors:

- Land to the west and east of the bypassed communities is generally already planned for commercial or industrial development along the Route 460 corridor.
- The western and eastern bypass termini do not provide new points of access to existing Route 460.
- The projected traffic volumes of CBA 1 and 3 are generally twice as high as the No-Build Alternative. Comparatively, traffic volumes on CBA 2 versus the No-Build Alternative are similar in magnitude as noted in Table 15.4-4, located at the end of this report. Therefore, the demand for additional goods and services would not increase.

Table 3.3-2 summarizes the direct and indirect land use impacts by CBA in acreage. Enough developable land is located within each one-mile interchange area to accommodate the acres of anticipated induced development. Developable land was considered to be either forest or in agricultural use for the following reasons. First, the remaining land use that is residential or commercial is already developed and would not absorb more development. Second, the remaining land use category of wetlands has regulations preventing a net loss of acreage.

CBAs 1 and 3 would result in the greatest amount of indirect land use impacts as a result of the conversion of an additional 340 and 380 acres, respectively. CBA 2 would result in the conversion of 50 acres of agricultural and forestlands. The effect of these additional land use impacts to agricultural and forestland will be discussed in further detail in Sections 6.0 and 7.0.

Table 3.3-2
DIRECT AND INDIRECT LAND USE IMPACTS BY CBA (ACRES)

Land Use	CBA 1				CBA 2				CBA 3			
	Direct Planning Corridor Impacts	Direct Design Corridor Impacts	Indirect Impacts	Total Impacts (Planning / Design)	Direct Planning Corridor Impacts	Direct Design Corridor Impacts	Indirect Impacts	Total Impacts (Planning / Design)	Direct Planning Corridor Impacts	Direct Design Corridor Impacts	Indirect Impacts	Total Impacts (Planning / Design)
Residential	195	113	0	195 / 133	340	129	0	340 / 129	155	74	0	155 / 74
Commercial	20	7	0	20 / 7	120	32	0	120 / 32	3	0	0	3 / 0
Industrial	0	0	0	0	36	9	0	36 / 9	0	0	0	0
Agricultural*	965	517	115	1,080 / 632	1,237	557	30	1,267 / 587	1,229	707	150	1,379 / 857
Forest [§]	2,184	1,140	225	2,409 / 1,365	1,370	599	20	1,390 / 619	1,931	998	230	2,161 / 1,228
Wetland [†]	30	14	0	30 / 14	50	18	0	50 / 18	56	25	0	56 / 25
Other [‡]	62	31	0	62 / 31	294	205	0	294 / 205	66	37	0	66 / 37
Total	3,456	1,822	340	3,796 / 2,162	3,447	1,549	50	3,497 / 1,599	3,440	1,842	380	3,820 / 2,222

Source: USGS, Parsons Brinckerhoff, and Michael Baker Jr.

*includes Cropland and Pasture, Confined Feeding Operations, and Other Agricultural Land

§ includes Evergreen Forest, Deciduous Forest, Mixed Forestland.

† includes Forested Wetland and Non-forested Wetland

‡ includes all water bodies, strip mines, transitional areas, utilities, other urban/built-up land, strip mines, and unclassified lands as defined by A Land Use and Land Cover Classification System for Use with Remote Sensing Data, James R. Anderson, et al.

The potential exists for development to also be affected beyond the interchange areas in the form of accelerated and/or piecemeal residential development. The impetus for this to occur would be the combination of decreased travel times and lower land prices in the areas beyond the existing suburban development. For this analysis, this potential indirect land use impact is termed “sprawl development” and is defined as new low-density residential development in existing rural areas. Existing commuting patterns reveal that Prince George residents are mainly traveling into employment centers west of the study area, while Isle of Wight, Suffolk, and Surry residents are commuting to major employment centers east or northeast of the study area. In order for areas further to the interior of the Route 460 corridor (i.e., Waverly, Wakefield, and Ivor) to become instantly attractive for these same commuter-sheds upon construction of a CBA, travel times would need to decrease relative to the 2026 No-Build condition sufficiently to offset the increased distance from the employment centers. If this were to occur, it would suggest a dramatic change in residential development pressures could occur with the CBA(s).

Based on an analysis of commuting patterns, land use plans, and existing and planned development patterns, the western commuter-shed is anticipated to extend as far east as the Disputanta area under the 2026 No-Build Alternative. Similarly, the eastern commuter-shed is anticipated to extend as far west as the Windsor area. Therefore, if Waverly residents experienced a travel-time reduction to Petersburg under one of the CBAs that made it as close in travel-time as Disputanta is from Petersburg, one could surmise that Waverly would become substantially more likely to have suburban residential development with that CBA.

Based on this logic, the access points on the interior of the study area (i.e., Waverly, Wakefield, and Ivor) were analyzed to determine if any CBA travel-time savings would result in drawing any of these areas inside the major employment centers’ commuter-sheds. For the 2026 No-Build Alternative, the travel-time from Disputanta to Petersburg would be 15 minutes and the travel time from Windsor to Suffolk would be 16 minutes. Therefore, a travel-time threshold of 15 to 16 minutes would be necessary to make Waverly, Wakefield, and Ivor more attractive residential locations for suburban sprawl commuters. (While total commute times tend to be longer than this, the remainder of commuters’ journeys would not be affected by the Route 460 improvements.)

As shown in Table 3.3-3, all travel times are greater than the No-Build condition’s 15 to 16 minute travel time threshold for the commuter threshold. This indicates that the new access points on the CBAs in the central portion of the study area would not provide the same degree of access (via travel-time savings) to major employment centers that would occur in areas within the easternmost and westernmost suburban commuter sheds of employment centers under the 2026 No-Build Alternative.

Given that the travel time savings would not instantly draw any other interchanges into the commuter sheds upon construction of a CBA, the development pressures for sprawl development in the study area are not expected to be great. However, suburban and exurban development patterns elsewhere in the state, such as Stafford and Fauquier Counties in northern Virginia, suggest that some residential development will eventually reach beyond the existing commuter sheds, and the travel time savings of the CBAs will make this somewhat more likely to occur. Development and its impacts will, however also depend on local actions including planning regulations and the provision of infrastructure. Sprawl development impacts cannot be measured, but based on local coordination and existing comprehensive plans, the lack of impetus from travel time savings, and the modest population growth rates expected in the interior of the study area (less than 0.5 percent annually), the sprawl development impacts are anticipated to be minor in extent.

Table 3.3-3
INTERIOR CORRIDOR TRAVEL TIMES TO MAJOR EMPLOYMENT CENTERS

Interchange	Employment Center	Travel Time to Employment Center		
		CBA 1	CBA 2	CBA 3
Waverly	Petersburg	25	29	25
Wakefield	Petersburg	35	39	34
Wakefield	Suffolk	32	32	30
Ivor	Suffolk	23	24	23

Source: Michael Baker Jr., Inc. 2005

4.0 INDIRECT SOCIAL IMPACTS

4.1 ASSUMPTIONS

This analysis considers different factors that have the potential to affect social interaction and stability in the seven communities along Route 460 in the study area. The direct and indirect community impacts considered include: displacements, safety, travel patterns and accessibility, economic impacts, and indirect change to land use. Potential direct and indirect impacts to both communities and neighborhoods are assessed in Section 2.0 in the *Socioeconomic Technical Report*, but this analysis addresses social impacts, or the need for social adaptation, that would result from a combination of the effects listed above for the seven communities along Route 460 in the study area.

Social adaptation impacts are not necessarily either positive or negative. Where impacts occur, they require that members of a community adjust and establish new or different patterns of social interaction. However, it is possible for the changes to the community to be so severe that the patterns of social interaction cannot be reestablished. The analysis indicates that none of the alternatives would so severely affect the communities that these levels of interaction could not be reestablished.

4.2 EVALUATION METHODS

Evaluation methods to identify social impacts included site analysis, mapping overlays, field review, as well as first-hand information provided during public involvement and information gathering meetings. In GIS, the displacement of residential, commercial, and non-profit facilities were displayed relative to the communities as a whole. Other direct and indirect community impacts, including induced development (Chapter 3) were evaluated in a matrix format. This format allowed for an assessment of the potential magnitude of change in social interaction and stability while providing a summary of the potential benefits and adverse impacts to residents within the study area. The following factors were used to assess indirect social impacts to communities:

- Displacements: number of residential units, name of businesses, and name of non-profit facilities (provided in the Right of Way and Relocation Technical Report).
- Visual or Noise Impacts: Potential for visual or noise impacts to communities (provided in the DEIS and the Noise Analysis Technical Report).
- Safety: Potential for changes in emergency response times will be noted. Increased or decreased likelihood for non-motorized travel will be noted, specifically if it impedes or enhances non-motorized access to businesses or community facilities. This analysis is based on GIS analysis and information provided during public involvement and interviews with stakeholders.
- Travel Patterns and Accessibility: Travel time changes to the western and eastern ends of the project corridor based on traffic model results.
- Economic impacts: The overall gain or loss of jobs in each community (provided in the Socioeconomic Technical Report).
- Effect of indirect land use changes: Potential for changes in land use at interchange areas (Table 3.3-1) were assessed as it may affect social interaction and stability.
- Overall impact to social interaction and stability: Based on the relative severity of the five factors identified above, and considering existing levels of social interaction and stability, a rating of low, low-moderate, moderate, or high is identified. Social adaptation can be both negative and positive; but, the main concern is the sustainability of the community as a whole. In general, these social impacts are considered low in communities with no displacements, no new traffic patterns, and no land use changes at interchange areas. Conversely, communities experiencing

considerable changes with regard to these factors would be expected to have moderate or high indirect social impact.

4.3 2026 NO-BUILD AND TSM ALTERNATIVES

The No-Build and TSM Alternatives would not result in any displacements or changes in local travel patterns. Currently, Route 460 bisects the communities of Disputanta, Waverly, Wakefield, Ivor, Zuni, and Kings Fork. Current traffic levels and lack of consistent paved shoulders limit bicycle and pedestrian mobility along Route 460 in each community. Future traffic increases, which include increases in truck traffic, could further limit bicycle and pedestrian mobility and increase the degree to which Route 460 bisects the communities. By the year 2026, average daily traffic volumes for the No-Build and TSM Alternatives are projected to increase between 34 and 70 percent over existing volumes. The national average for truck traffic on rural arterial highways is 10 percent (FHWA, 1996). In contrast, the percentage of truck traffic on Route 460 ranges from 18 to 30 percent under existing conditions and will increase to a range of 30 to 37 percent in 2026 with the No Build and TSM Alternatives. Due to the high percent of truck traffic, high travel speeds, and a lack of protected turning movements, residents have noted throughout the public involvement process their concerns with regard to safety when crossing or turning on Route 460. Local services such as emergency service response, mail delivery, and school bus routes are also sensitive to these increases in traffic and truck volumes.

4.4 CANDIDATE BUILD ALTERNATIVES

Table 4.4-1 through Table 4.4-3 summarize the direct and indirect factors that influence social interaction and stability under each CBA. The adverse social impacts of the CBAs include displacements and or introduction of new impediments to non-vehicular traffic. The positive impacts include improved access for emergency vehicles, reduced travel times, and increases in local employment. Additional social impacts that cause change that may ultimately be either positive or negative include “bypass effects” that will cause change in local business districts and indirect land use impacts at interchanges that will change community dynamics. In aggregate, all three CBAs have similar indirect social impacts with two exceptions:

- CBA 1 would result in moderate changes to levels of social interaction and stability in Waverly.
- CBA 2 would result in low-moderate changes in social interaction and stability in Zuni.

Noting these exceptions, the indirect social impacts are as follows, with the basis for the level of impact indicated. The results are also shown graphically in Figure 4.4-1 to Figure 4.4-3.

- Disputanta - low (no negative impacts and indirect land use impacts only to timing of development)
- Waverly – low/moderate (induced land use at interchanges and bypass effects)
- Wakefield – low/moderate (induced land use at interchanges and bypass effects)
- Ivor – low/moderate (bypass effects and indirect impacts to timing of development)
- Zuni – low (no negative impacts or indirect land use impacts)
- Windsor – low/moderate (displacements, changes in traffic patterns, bypass effects, indirect land use impacts)
- Kings Fork – low (small number of displacements, no other negative impacts or impacts to land use)

Table 4.4-1
SOCIAL EFFECTS: CBA 1

Community	Total Number of Displacements	Visual / Noise	Safety	Accessibility Travel Time Savings		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
Disputanta	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route.	2 min.	18 min	No employment loss in Disputanta.	No change in planned land use.	Low
Waverly	11 residences Shilo Holiness Church	Visual: Impact, not adverse Noise: 4 impacts	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route. Non-motorized travel would be affected by increased traffic levels on Route 40 at the interchange ramp areas.	4 min	12 min	No employment loss in Waverly. Increased employment at interchange area due to indirect land use changes. Community has expressed concern for bypass-related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from forestland uses to light tourist / commercial services at the interchange area.	Moderate
Wakefield	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route.	6 min	8 min	No employment loss in Wakefield. Increased employment south of Waverly at interchange area due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	This interchange would provide direct access to the planned Drumwright Mill Subdivision (500-lots) located south of Wakefield. It is anticipated that this project will result in the conversion from agricultural use to light tourist / commercial services	Low - Moderate

Community	Total Number of Displacements	Visual / Noise	Safety	Accessibility Travel Time Savings		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
							at the interchange area.	
Ivor	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route.	9 min	7 min	No employment loss in Ivor. Community has expressed concern for bypass related economic impacts.	No change in planned land use, may increase rate of planned development.	Low - Moderate
Zuni	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460.	11 min	5 min	No employment loss in Zuni.	No change in planned land use.	Low
Windsor	2 residences	Visual: Impact, not adverse Noise: 12 impacts	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route. Non-motorized travel would be affected by increased traffic levels on Route 258 (Bank Street) at the interchange ramp areas.	15 min	5 min	No employment loss in Windsor. Community has expressed concern for bypass related economic impacts.	No change in planned land use, may increase rate of planned development.	Low - Moderate
Kings Fork	3 residences in Planning Corridor and 2 residences in Design Corridor	Visual: no impact Noise: 10 impacts	No change	18 min	1 min	No employment loss in Kings Fork.	No change in planned land use.	Low

Source: Parsons Brinckerhoff and Michael Baker Jr., 2005.

Table 4.4-2
SOCIAL EFFECTS: CBA 2

Community	Total Number Displacements	Visual / Noise	Safety	Accessibility (Travel Time Savings)		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
Disputanta	4 residences	Visual: Impact, not adverse Noise: 3 impacts	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460.	0 min	11 min	No employment loss in Disputanta.	No change in planned land use, may increase rate of planned development.	Low
Waverly	No displacements	Visual: Impact, not adverse Noise: 8 impacts	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460.	Additional 1 min	10 min	No employment loss in Waverly. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural and forestland uses to light tourist / commercial services at the interchange area.	Low - Moderate
Wakefield	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460. Increased traffic through Mars Hill neighborhood on Route 31.	1 min	8 min	No employment loss in Wakefield. Community has expressed concern for bypass related economic impacts.	No change in planned land use, may increase rate of planned development.	Low – Moderate

Community	Total Number Displacements	Visual / Noise	Safety	Accessibility (Travel Time Savings)		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
Ivor	No displacements	Visual: Impact, not adverse Noise: no impact	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460.	3 min	6 min	No employment loss in Ivor. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural and forestland uses to light tourist / commercial services at the interchange area.	Low - Moderate
Zuni	4 residences	Visual: Impact, not adverse Noise: no impact	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460.	4 min	5 min	No employment loss in Zuni.	No change in planned land use.	Low - Moderate
Windsor	8 residences	Visual: Impact, not adverse Noise: 34 impacts	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460. Non-motorized travel would be affected by increased traffic levels on Route 258 at the interchange ramp areas.	4 min	5 min	No employment loss in Windsor. Community has expressed concern for bypass related economic impacts.	No change in planned land use.	Low - Moderate
Kings Fork	3 residences in Planning Corridor and 2 residences in Design Corridor	Noise: 8 impacts	No change	9 min	1 min	No employment loss in Kings Fork.	No change in planned land use.	Low

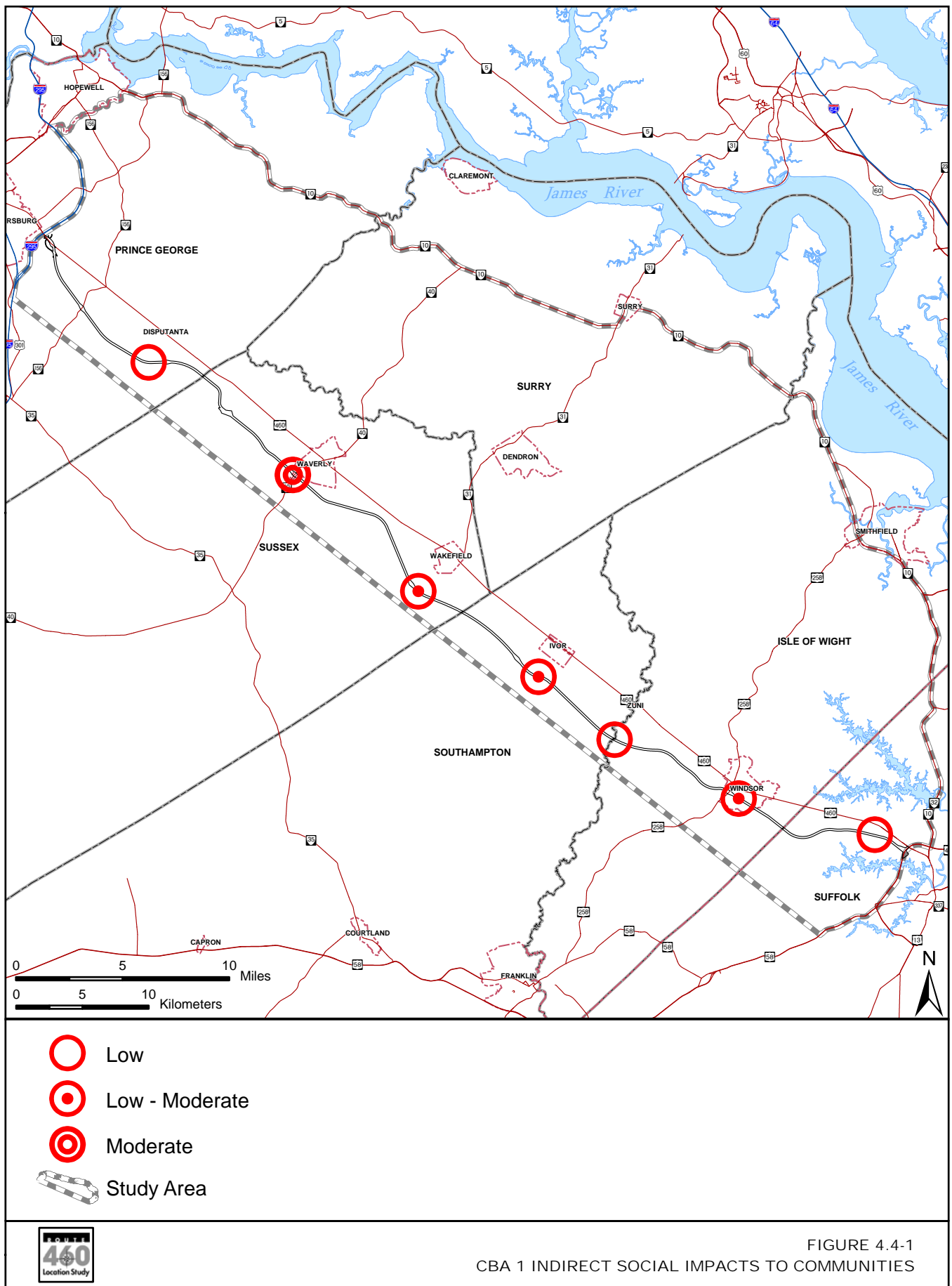
Source: Parsons Brinckerhoff and Michael Baker Jr., 2005.

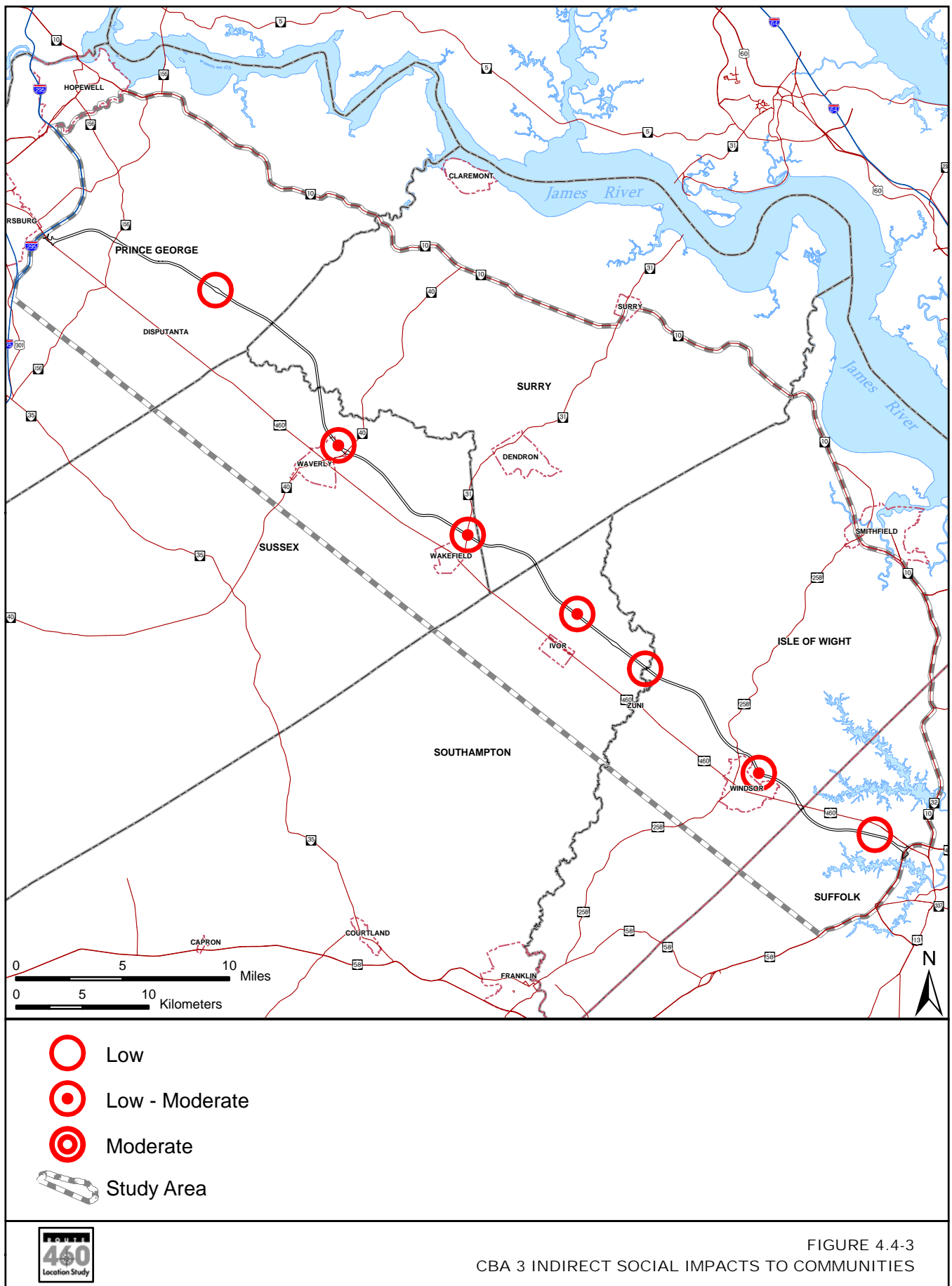
Table 4.4-3
SOCIAL EFFECTS: CBA 3

Community	Total Number of Displacements	Visual / Noise	Safety	Accessibility (Travel Time Savings)		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
Disputanta	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route.	2 min.	18 min	No employment loss in Disputanta.	No change in planned land use	Low
Waverly	No displacements	Visual: Impact, not adverse Noise: 5 impacts	Improved mobility for emergency vehicles and non-motorized travel on Route 460. Direct access to additional hurricane evacuation route.	4 min	15 min	No employment loss in Waverly. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural and forestland uses to light tourist / commercial services at the interchange area.	Low - Moderate
Wakefield	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Increased traffic through Mars Hill neighborhood on Route 31. Direct access to additional hurricane evacuation route.	7 min	10 min	No employment loss in Wakefield. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural and forestland uses to light tourist / commercial services at the interchange area.	Low-Moderate

Community	Total Number of Displacements	Visual / Noise	Safety	Accessibility (Travel Time Savings)		Economic	Effect of Indirect Land use Changes	Change in Social Interaction and Stability
				To Petersburg	To Suffolk			
Ivor	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel due to decreased traffic on Route 460. Direct access to additional hurricane evacuation route.	8 min	7 min	No employment loss in Ivor. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural land uses to light tourist / commercial services at the interchange area.	Low - Moderate
Zuni	No displacements	No impact	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460.	10 min	5 min	No employment loss in Zuni.	No change in planned land use.	Low
Windsor	No displacements	Visual: Impact, not adverse Noise: 42 impacts	Improved mobility for emergency vehicles and non-motorized travel within community due to decreased traffic on Route 460. Non-motorized travel would be affected by increased traffic levels on Route 258 at the interchange ramp areas. Direct access to additional hurricane evacuation route.	14 min	5 min	No employment loss in Windsor. Increased employment at interchange due to indirect land use changes. Community has expressed concern for bypass related economic impacts.	Land use change would occur beyond the community of Windsor. Slight to moderate change in type of planned land use. Anticipate a conversion from agricultural and forestland uses to light tourist / commercial services at the interchange area.	Low - Moderate
Kings Fork	3 residences in Planning Corridor and 2 residences in Design Corridor	Noise: 9 impacts	No change	18 min	1 min	No employment loss in Kings Fork.	No change in planned land use.	Low

Source: Parsons Brinckerhoff and Michael Baker Jr., 2005.





5.0 INDIRECT ECONOMIC IMPACTS

Indirect economic impacts include the economic impacts of potential land use changes, the potential economic losses to bypassed communities, and the economic benefits of travel time savings to industrial developments in the study area.

5.1 ASSUMPTIONS AND EVALUATION METHODS

The indirect economic impact analysis assumes that the traffic levels on Route 460 and any CBAs are a major determinant of the location of some businesses. The indirect land use analysis estimated the number and type of businesses that would locate in CBA interchange areas. This analysis considers the likely economic impacts that would result from different traffic levels along Route 460 as well as the at the new interchange areas, and the general extent to which those impacts may be offsetting. The analysis also assumes that travel time savings provide an economic benefit to industrial development along the corridor, which also may have positive economic impacts.

Due to the speculative nature of predicting employment losses and gains, the analysis of indirect employment impacts is mainly qualitative, with general quantitative results that enable comparisons. The analysis is based on existing and planned land use and the indirect land use impact analysis. The analysis of the economic effects to bypassed communities relies on empirical research reported in transportation literature and application of that research to the travel time and bypass characteristics of the CBAs relative to each bypassed community.

5.2 NO-BUILD AND TSM ALTERNATIVES

The No-Build and TSM alternatives would not bypass the existing business districts along Route 460, nor would result in land use changes since no new-location interchanges would be provided. The maintenance and growth of traffic levels along Route 460 would support existing and future highway-oriented businesses. However, the high levels of truck traffic and high traffic volumes by 2026 could discourage the development of non-highway-oriented businesses due to access and safety concerns by motorists and pedestrians. As shown in Table 5.3-1, average daily traffic volumes for these two alternatives are projected to increase between 34 to 70 percent over existing volumes. In addition, the percentage of truck traffic is projected to increase from 6 to 11 percent compared to current truck volumes. On rural arterial highways like Route 460, the national average for truck volumes is 10 percent (FHWA). Under the No-Build and TSM Alternatives, the truck volumes would range from 30 to 37 percent of total traffic. With this substantial volume of truck traffic passing through the downtowns of communities along Route 460, access to local businesses will become more difficult, the visibility of local businesses will be reduced, and noise levels will increase.

Travel times under the No-Build and TSM Alternatives would also increase. Between Petersburg and Suffolk, travel times would increase by 11 percent (8 minutes) over the existing condition (Table 15.4-4). This increased travel time places an increasing burden on commuting workers, the delivery of goods and services, and the desirability of the Route 460 corridor for development purposes.

5.3 CANDIDATE BUILD ALTERNATIVES

5.3.1 Indirect Economic Benefits

Indirect economic benefits of the CBAs include development of businesses at new interchange areas, as described under indirect land use impacts, and travel time savings for industrial areas with access to the

CBA. The indirect economic benefits of the CBAs in terms of the number of interchanges with induced commercial development and the number of industrial areas with improved access are as follows:

- CBA 1 – Three interchanges and five industrial areas.
- CBA 2 – Four interchanges and five industrial areas.
- CBA 3 – Five interchanges and three industrial areas.

The interchange areas are discussed in detail in Section 3.3.2 and the planned industrial areas are described in more detail in Table 15.4-2. A negative consequence of the economic benefits in interchange areas could be the failure of businesses in existing business districts along Route 460 to remain profitable when traffic levels decline. This is discussed in the following section. However, total traffic on Route 460 and the CBAs is higher with the CBAs than it is in the No Build Alternative, which suggests that there will be a net increase in economic opportunities for automobile-dependent businesses with the CBAs.

5.3.2 Bypass Effects

To determine the potential impacts to communities bypassed by a CBA, it was necessary to establish criteria and general assumptions. An extensive literature review of analyses of small town bypasses was conducted for this study. The general findings of the literature review are best summarized by Weisbrod:

“The many highway bypass studies carried out around the country provide a generally consistent story. They indicate new highways bypassing the central business district of a community are seldom devastating or the savior of the area. The locational shift in traffic can cause some existing businesses to close up or relocate, but it can also create some new business opportunities. Net economic impacts on the broader community are usually relatively small (negative or positive). Downtown business districts having a strong identity as a destination for visitors or for local shoppers are the ones most likely to be strengthened due to the reduction in traffic delays through their centers. However, there is also a broad perception that adequate signage to the bypassed business center is an important need (and concern) for ensuring its continued success.”

“Across the case studies, some positive and negative factors are common. The positive benefits of bypassing downtown areas commonly include the removal of heavy truck traffic from central areas and the opening up of additional industrial sites along the new route, thus attracting new investment from outside the region. The negative impacts sometimes include increases in sprawled, low density commercial and residential development that entail additional environmental and infrastructure costs.”

Local economic development and planning officials from bypassed communities in the literature review consistently reported mostly positive impacts related to a bypass (FHWA, 2002). Based on the literature review, the bypass impacts experienced by rural and small urban communities can be grouped into the following categories: general community, trucking and service sector, commuting workers, and retail. Findings of the literature review for each of these topics is summarized below.

General Community Economic Impacts

- Property values increased along the new highway, especially in areas near the interchanges.
- Both private vehicle operators and truckers benefited from better access, reduced travel times, and improved safety and driving conditions.
- Generally, bypasses and new highways create shifts in traffic patterns that affect downtown businesses. With the diversion of through-truck traffic to the bypass or new highway, bypassed downtown areas experience increased visibility and accessibility of businesses along the main street of town. However, bypasses and new highways also facilitate the shift of local shoppers from the smaller local communities to the larger urban centers.

- Highway-oriented businesses such as gas stations, motels, restaurants, and convenience stores are typically the first wave of development for many of the communities along a new highway and bypass.
- In one case study with a similar project and project area, within seven years after construction, the total number of businesses within five miles of the highway interchange areas increased by 74 percent. At a county-wide level, new and expanding jobs in the counties along the improved highway increased by more than twice the number of jobs created in the previous six years.
- Communities who adopted proactive local planning strategies were able to take advantage of the bypass's ability to increase local economic development. Communities along and near the new highway who accelerated their planning efforts for commercial and industrial development, especially near the new interchanges, were those who most benefited from the roadway improvement.

Trucking and Service Sector Impacts

- Bypasses and new highways made truck travel more convenient and safer. In addition, travel speeds increased and the reliability and efficiency (shorter delivery time) of the delivery of goods improved.
- The service sector directly benefited from the trucking industry's ability to deliver goods faster and in a more reliable manner.

Impacts on Commuting Workers

- For most workers, traveling to work became faster, safer, and more convenient. Workers commuting over greater distances found the new highway and bypasses to be faster and safer. Workers commuting to bypassed downtowns found the roadway much less congested with improved visibility and vehicle traffic flow.
- Due to the reduced travel times, employment prospects for many workers were improved as they could access a wider variety of jobs.

Retail Impacts

- Retailers said the overall reduction of traffic in their downtown areas had a positive impact on local businesses. Because the bypasses reduced truck traffic, more people had better access to downtown businesses. In bypassed communities, businesses relying on local customers fared well.
- One negative aspect associated with bypasses was that businesses dependent on highway-related trips did not fare well for two reasons. First, because traffic volumes were substantially reduced, the likelihood of through-travelers diverting their trip into town was reduced. Second, when travel times are improved, it becomes more convenient for local residents to travel to other destinations for shopping. In smaller communities, many retailers experienced the challenge of attracting customers to shop at their stores rather than in the larger communities.

Overall, the benefits identified above would be maximized under CBAs 1 and 3 because they are on new alignment, are limited access via interchanges, and provide for the safe, free-flow of traffic at much higher speeds. In an attempt to further establish differences in bypass effects between CBAs, the following items were evaluated:

- Travel time savings,
- Reduction in overall traffic volumes and percentage of truck traffic, and
- Accessibility to or distance from the new bypass interchange to a community's downtown area.

Travel Time Savings

As shown in Table 15.4-4, travel time savings for CBA 1 or 3, from Petersburg to Suffolk, would be approximately 21 minutes (26 percent) compared to the No-Build Alternative. Under CBA 2, this savings would be approximately 10 minutes (12 percent). Existing, at-grade intersections along Route 460, many of which are signalized, are maintained under CBA 2. As a result, travel time savings would not be as great as they would be for CBA 1 or 3.

Workers commuting from any of the six bypassed communities would benefit the most from the travel time savings afforded under CBA 1 or 3. One of the adverse impacts associated with travel time savings is that CBA 1, 2, or 3 could facilitate the shift of local shoppers from the smaller local communities to the larger urban centers. However, as noted in the literature review, business districts having a strong identity as a destination for visitors or for local shoppers are the ones most likely to be strengthened due to the reduction in traffic delays through their centers.

Reduction in Traffic Volumes and Truck Traffic

Reducing traffic volumes through a community's downtown area creates both positive and negative impacts. The quality of life through the bypassed downtown area is improved substantially as congestion and vehicular noise are reduced, visibility and safety improved, and accessibility to local businesses and services is greatly improved. However, travel-oriented businesses such as gas stations, truck stops, motels, fast-food restaurants, and tourist-oriented shops could suffer from the shift in travel patterns and reduction in traffic passing by their respective businesses. On Route 460 through the downtown areas of Disputanta, Waverly, Wakefield, Ivor, Zuni, and Windsor, overall average daily traffic (ADT) volumes under the No-Build Alternative would be between 14,400 to 19,500 (Table 5.3-1). The CBAs would substantially reduce traffic volumes on existing Route 460 through the bypassed downtown areas relative to the No-Build Alternative:

- Under CBA 1, existing Route 460 would have an ADT of 1,500 to 4,500 (76 to 90 percent reduction in ADT),
- Under CBA 2, existing Route 460 through the communities would have an ADT of 1,500 to 4,500 (73 to 90 percent reduction in ADT), and
- Under CBA 3, existing Route 460 would have an ADT of 1,400 to 8,000 (49 to 90 percent reduction in ADT).

**Table 5.3-1
COMPARISON OF EXISTING ROUTE 460 ADT IN BYPASSED COMMUNITIES**

BYPASSED COMMUNITIES	Existing Route 460		2026 No-Build & TSM			CBA 1			CBA 2			CBA 3		
	ADT	% Truck s	ADT	% Change over Existing ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s
Disputanta (Route 460 between Rt 618 and Rt 625)	11,000	30%	14,800	35%	36%	3600	-76%	9%	1700	-89%	8%	5500	-63%	9%
West of Waverly (Route 460 - Between Rt 602 and Waverly bypass)	8,600	28%	13,600	58%	37%	1400	-90%	9%	17100	26%	35%	3200	-76%	9%
Waverly (Route 460 between Rt 40 and Rt 606))	9,300	28%	14,400	55%	37%	1500	-90%	9%	1800	-88%	9%	1400	-90%	9%
East of Waverly (Route 460 - between Waverly and Wakefield bypasses)	12,900	28%	18,600	44%	34%	4000	-78%	9%	20700	11%	34%	3500	-81%	9%
West of Wakefield (Route 460 - between Waverly and Wakefield bypasses)	12,900	28%	18,600	44%	34%	4000	-78%	9%	20700	11%	34%	3500	-81%	9%
Wakefield (Route 460 between Rt 604 and Rt 31)	11,300	28%	16,900	50%	34%	2400	-86%	9%	2100	-88%	8%	3500	-79%	9%
East of Wakefield (Route 460 - Between Wakefield and Ivor bypasses)	9,000	28%	14,200	58%	34%	2500	-82%	8%	19600	38%	34%	2200	-85%	8%
West of Ivor (Route 460 - Between Wakefield and Ivor bypasses)	9,000	28%	14,200	58%	34%	2500	-82%	8%	19600	38%	34%	2200	-85%	8%

BYPASSED COMMUNITIES	Existing Route 460		2026 No-Build & TSM			CBA 1			CBA 2			CBA 3		
	ADT	% Truck s	ADT	% Change over Existing ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s	ADT	% Change over 2026 No- Build ADT	% Truck s
Ivor (Route 460 immediately west of Rt 616)	7,900	23%	13,000	65%	34%	2400	-82%	8%	1300	-90%	7%	1900	-85%	7%
East of Ivor (Route 460 - Between Ivor and Zuni bypasses)	6,700	23%	11,400	70%	34%	2600	-77%	7%	16000	40%	31%	1400	-88%	7%
West of Zuni (460 - Between Ivor and Zuni bypasses)	6,700	23%	11,400	70%	34%	2600	-77%	7%	16000	40%	31%	1400	-88%	7%
Zuni (Route 460 just east of Route 644)	8,500	23%	13,600	60%	34%	1500	-89%	7%	1100	-92%	7%	1600	-88%	7%
East of Zuni (Route 460 East of Town)	8,500	23%	13,600	60%	32%	1500	-89%	7%	17300	27%	30%	1600	-88%	7%
West of Windsor (Route 460 West of Town)	8,500	23%	13,600	60%	32%	1500	-89%	7%	17300	27%	30%	1600	-88%	7%
Windsor (Route 460 at between 258 and Rt 603)	14,600	23%	19,500	34%	30%	4500	-77%	7%	5000	-74%	7%	8000	-59%	7%
East of Windsor (Route 460 - East of Town)	12,600	23%	18,200	44%	30%	4800	-74%	7%	5000	-73%	7%	9300	-49%	7%

Table 5.3-1 also shows that the percentage of truck traffic on existing Route 460 in the downtowns of bypassed communities would be between 7 and 9 percent of total traffic volumes compared to 30 to 37 percent under the No-Build Alternative. For CBA 2, the percentage of truck traffic on existing Route 460 through the bypassed communities would also be between 7 and 9 percent. Given that the national average for truck traffic on similar rural arterials is 10 percent these truck volumes would be more in keeping with the national average.

Accessibility to Downtown Areas via Bypass

A distance of approximately 1 to 1.5 miles is assumed to be the threshold for whether a traveler on the bypass will exit onto a secondary road in order to obtain goods and services in the nearby town. As shown in Table 5.3-2, all of the proposed interchanges under CBA 2 are within this range. Given the proximity of the bypassed communities from the bypass, it is more likely that travelers on CBA 2 would travel into the downtown area to obtain goods and services. Under CBA 1 or 3, the further the bypass interchange is from the downtown area, the more likely it is that through-traffic will continue to the next exit that offers goods and services within this 1 to 1.5 mile range. Two interchanges in each of CBA 1 and 3 are greater than two miles from the bypassed community. A detailed analysis of potential land use changes and the likelihood of new interchange areas being developed is provided in Chapter 3. CBA 1 has three interchange areas with induced commercial development, while CBA 2 has four areas and CBA 3 has six.

Table 5.3-2
DISTANCE OF BYPASS INTERCHANGE TO ROUTE 460 IN DOWNTOWN AREA

BYPASSED COMMUNITY	CBA 1	CBA 2	CBA 3
Disputanta	1.5 miles	0.5 mile	3.3 miles
Waverly	1.6 miles	1.2 miles	1.2 miles
Wakefield	2.9 miles	1.3 miles	1.3 miles
Ivor	2.3 miles	0.9 mile	2.5 miles
Zuni*	---	---	---
Windsor	0.5 miles	0.8 mile	1.5 miles

* No interchange access would be provided to Zuni via CBA 1, 2, or 3. However, CBA 2 would provide at-grade intersections on existing Route 460 at the western and eastern sides of Zuni.

Summary of Bypass Effects

The CBAs are anticipated to have similar bypass effects to existing downtown businesses on the basis of changes in traffic levels. CBA 3 is projected to have the most new, competing commercial development areas at interchanges, while CBA 1 would have the least. The distance of the bypass interchanges to the existing downtown areas is small enough at all interchanges with CBA 2 to infer that drivers will visit the downtown areas from the bypasses. With CBAs 1 and 3, there are two interchanges where this distance exceeds the assumed threshold of through-travelers' willingness to venture into downtown areas for goods and services.

Given that all six of the bypassed communities have some sort of highway-related business, such businesses will likely experience a short-term decline in revenues due to the shift of through-traffic. The towns of Waverly, Wakefield, and Windsor have the greatest number of highway-related businesses. Therefore, these towns could be the most adversely affected in this regard. However, these towns are also the largest of the communities along the Route 460 corridor and are more self-sufficient than communities such as Disputanta, Ivor, and Zuni. This self-sufficiency and local support of these highway-

related businesses could offset the reduction in through-traffic business. With the shifting of traffic to CBA 1, 2, or 3, access to businesses in the downtown areas becomes easier and more convenient.

Towns that rely on revenues generated through speeding tickets issued along Route 460 through their town limits will likely experience an economic shortfall with a reduction in traffic through town. This would be the case under any of the CBAs. It is unlikely that these lost revenues could ever be recouped.

6.0 INDIRECT FARMLANDS IMPACTS

Agricultural land uses are discussed in detail in the *Land Use, Parklands, and Farmlands Technical Report*. All jurisdictions within the study area have a considerable amount of acreage devoted to agricultural purposes. Indirect impacts to farmlands include farmland fragmentation and impacts to farmland from induced development. Farmland fragmentation is the division of agricultural parcels into smaller pieces, which in turn may result in reduced efficiency in farm operations and/or creation of farmland remnants that are not economical for agricultural production. This impact analysis assumes that farmland fragmentation has the potential to occur where the roadway is proposed on new location in agricultural areas. In areas with indirect land use impacts, agricultural land is assumed to be the most attractive land for development relative to forested land uses. Properties least likely for development include locally or federally protected lands in agricultural and forestal districts and waters of the U.S. (e.g. jurisdictional wetlands).

Detailed analysis of farmland fragmentation would require a defined threshold of uneconomic remnants and parcel-level analysis of individual farmland impacts. This would also entail research on parcels that are farmed jointly. The scale of the Route 460 project made this level of analysis impractical, particularly given that parcel-level farmland impacts will be minimized during project final design. However, for purposes of comparing project alternatives, the question of farmland fragmentation is assessed in aggregate.

The impacts of induced development on agricultural land were estimated using land cover data in GIS within a one-mile radius around proposed interchanges. Calculation of land use impacts and allocation within interchange areas is described in Section 3.2.

The No-Build and TSM Alternatives would not include roadway on new location. Therefore, farmland fragmentation impacts would not occur with these alternatives. Induced development is not anticipated with the No-Build or TSM Alternative.

As noted above, farmland fragmentation is assumed to have the potential to occur where an alternative is proposed on new location in agricultural areas. Where the roadway is proposed to be widened in place, agricultural acres may be impacted but no new fragmentation of farmland would occur. Therefore, CBAs 1 and 3 have the potential to fragment farmland anywhere that they pass through agricultural areas, whereas CBA 2 has the potential for these impacts only in the area of the bypasses. As detailed in the *Land Use, Farmlands and Parklands Technical Report*, CBA 2 has the greatest direct impacts to agricultural land (1,237 acres), but CBA 2 would be expected to have the least indirect impacts to farmland fragmentation because of the limited areas in which these impacts would occur on new location. In aggregate, CBA 1 and CBA 3 would be expected to have similar farmland fragmentation impacts because the scale of their new location impacts on agricultural land is similar.

Impacts to agricultural and forestal districts have been minimized in the proposed CBA alignments; therefore, indirect impacts to farmlands have already been minimized to some degree. During final design, the parcel-level impacts to farms will be minimized, which will further reduce farmland fragmentation. If a CBA were selected, any uneconomic remnants that would be created by the selected alternative would be purchased during right-of-way acquisition.

Additional indirect impacts to agricultural land will occur where projected land use changes occur and displace agricultural land uses. Based on the analysis in Section 3.3.2, the CBAs are estimated to have the following indirect impacts to agricultural land in interchange areas:

- CBA 1 – 115 acres
- CBA 2 – 30 acres
- CBA 3 – 150 acres



The interchange area at CBA 1 in Isle of Wight County includes 40 acres of land within the Knoxville District Agricultural and Forestal Districts. As long as this land remains within the district, it will not be developed for more intensive land uses. In addition to zoning restrictions, should localities want to limit induced development at associated interchange areas and preserve agricultural land uses, they can consider supporting or encouraging agricultural and forestal districts to preserve and protect open spaces, forested areas, and agricultural lands.

The potential for these impacts in combination with direct project impacts and the past, present and future actions in the study area to impact the sustainability of agriculture is assessed in Table 15.4-4 under Cumulative Impacts.

7.0 INDIRECT TERRESTRIAL COMMUNITIES, HABITAT, AND BIODIVERSITY IMPACTS

7.1 ASSUMPTIONS AND EVALUATION METHODS

For purposes of this assessment, forestland is used as the primary indicator of terrestrial wildlife habitat and biodiversity. Habitat impacts of federally-listed threatened and endangered species are discussed separately in Section 11.0. The majority of the forestlands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, residential and commercial development. Forestland uses are discussed in detail in the *Land Use, Parklands, and Farmlands Technical Report* and terrestrial resources are discussed in the *Natural Resources Technical Report*.

The indirect land use analysis assumes that impacts to forestland may result from forest fragmentation and the conversion of forest habitat due to indirect land use changes. Detailed analysis of forestland fragmentation would require a parcel-level analysis of individual forest impacts. The scale of the Route 460 project made this level of analysis impractical, particularly given that most forestland in the study area is highly fragmented. The amount of agricultural land use conversion versus forestland conversion depends on its location and availability within each interchange area. It was assumed that agricultural lands were slightly more attractive as potential development locations than forestlands.

Locations of forestland uses were compared to the locations of induced development identified in Section 4.1. Each 2,000-acre interchange area was reviewed for the amount and type of developable land. Anticipated land use changes were allocated to available land based on the assumption that accessible, agricultural land would develop first, followed by accessible forested non-wetland acres. In every case, these two land types, outside of agricultural and forestal districts, were more than sufficient to absorb the projected development. However, specific parcels for development were not determined. Indirect impacts evaluated for these areas are incremental habitat loss, forest fragmentation, and resulting effects upon regional biodiversity.

As reported in the *Natural Resources Technical Report*, uplands within certain portions of the study area are so highly fragmented that they afford limited contribution with respect to wildlife corridors; however, riparian corridors and a number of headwater areas in the western portion of the study area have been less disturbed and presently serve as components of several prominent wildlife corridors within the region. These corridors are associated with relatively wide and contiguous forest communities. Indirect impacts to these communities could occur where the CBAs cross the wildlife corridors or if interchange-area development might encroach on these areas. Further forest fragmentation in uplands not associated with the aforementioned areas is not likely to greatly affect the biodiversity of those terrestrial communities on a local basis due to the existing level of fragmentation.

Biodiversity impacts are assessed on the basis of wildlife corridor impacts in combination with acreage impacts on terrestrial natural communities and encroachments on biodiversity-ranked communities (or BRANKs). The potential for indirect biodiversity effects is based on the assessment of these factors in the interchange areas where induced development is projected to occur.

7.2 INDIRECT TERRESTRIAL COMMUNITIES AND HABITAT IMPACTS

Indirect impacts to terrestrial communities include forest fragmentation and the conversion of forest habitat due to land use changes. As discussed in the *Natural Resources Technical Report*, the majority of the forestlands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, residential and commercial development and, as such, provide limited terrestrial habitat.

The No-Build and TSM alternatives would result in some indirect impacts to wildlife habitat, but these effects would occur within or adjacent to the existing de-forested corridor and are expected to be negligible.

Forestland fragmentation is assumed to have the potential to occur where an alternative is proposed on new location in forested areas. Where the roadway is proposed to be widened in place, forest fragmentation and edge effects have already occurred. Therefore, CBAs 1 and 3 have a greater potential to fragment forest habitat anywhere that they pass through non-fragmented forest areas, whereas CBA 2 has the potential for these impacts only in the area of the bypasses.

CBA 1 would result in the conversion of 225 acres of forestland uses as a result of indirect land use impacts near interchanges; this acreage is less than 0.1 percent of the forestland in the study area. None of the CBA 1 interchanges or induced development would bisect a wildlife corridor or affect a BRANK area.

CBA 2 would result in the conversion of 20 acres of forestland uses as a result of indirect land use impacts in interchange areas, which is less than 0.01 percent of forestland in the study area. CBA 2 would affect neither wildlife corridors nor BRANK areas in the interchange areas that are anticipated to have induced development impacts.

CBA 3 would result in 230 acres of converted forestland as a result of indirect land use impacts at interchange areas. This is less than 0.1 percent of the forestland in the study area. While one CBA 3 interchange (Route 625 near Disputanta) is in the vicinity of a wildlife crossing and BRANK area, no change in future land use is anticipated to occur at this interchange as a result of CBA 3.

8.0 INDIRECT IMPACTS TO WATERS OF THE U.S., INCLUDING WETLANDS, AND ASSOCIATED AQUATIC HABITAT

Based on analysis in the *Natural Resources Technical Report*, no trout streams, essential fish habitat, or habitat for federally-listed threatened and endangered aquatic species would be indirectly affected. It is assumed that the project will incorporate the wetland and stream mitigation measures identified in the *Natural Resources Technical Report*, that floodways and larger, high-quality wetland systems will be spanned, and that fill in floodplains will be minimized.

Indirect impacts to navigable waterways, streams, ponds, and wetlands may occur as a result of indirect land use impacts or downstream effects from the direct impacts of project alternatives. The severity of these impacts along with appropriate mitigation measures will be regulated by state and federal permitting processes that will minimize impacts from the proposed roadway project. State, federal, and additional local regulations would apply to most induced development projects. Regulatory permit programs that will serve to regulate the degree and extent of future indirect impacts include:

- VDEQ regulates activities affecting jurisdictional wetlands, streams, and other waters of the state. VDEQ issues two permits: the Virginia Pollutant Discharge Elimination System (VPDES) and the Virginia Water Protection Permit (VWPP). Any proposed action disturbing more than one acre of land must obtain a VPDES permit, which governs discharges of stormwater from construction activities.
- Local ordinances implementing minimum state requirements pertaining to erosion and sediment control and Chesapeake Bay regulations.
- Section 404 of the Clean Water Act of 1977, as administered by the COE (and VDEQ under the VWPP), requires the avoidance, minimization, and mitigation of impacts to wetlands.
- The Virginia Marine Resources Commission (VMRC) is authorized to permit activities in, on, or over state-owned subaqueous lands in Virginia. VMRC and, where applicable, local municipal Wetlands Boards, have the authority to permit encroachments of state-owned stream bottoms and other resources including vegetated and unvegetated wetlands. Under the Virginia Joint Permit Application (JPA) process, future projects affecting waters of the state in the vicinity of proposed interchanges would be subject to review by VMRC and local Wetland Boards.

If individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) required encroachment upon wetlands or streams, such encroachments can be expected to be relatively minor in extent and severity. Yet, these alternatives would not resolve any existing stormwater management problems or bring existing stormwater treatment facilities along the Route 460 corridor up to current standards.

As detailed in the *Natural Resources Technical Report*, CBA 3 has the greatest quantity of wetland and stream crossing impacts, followed by CBA 1. CBA 2 has the least impacts to these resources. Indirect impacts associated with these encroachments, such as pollutant loading, thermal and sedimentation effects at stream crossings, streambed erosion, effects to downstream aquatic habitat, and impacts to downstream wetland hydrology, would be minimized by the use of best management practices during construction and the collection and retention of storm water according to best management practices and as required by VDEQ. Indirect impacts to stream beds and aquatic habitat located downstream of streams crossed by a CBA would be mitigated through restoration of disturbed stream banks/substrate and land surfaces immediately following construction and through provision of storm water management facilities designed to address both water quantity and water quality. In addition to having fewer crossings and encroachments on waters of the U.S., CBA 2 would provide a beneficial indirect impact along the

existing Route 460 corridor by affording the opportunity to improve any deficient stormwater management facilities and reduce pollutant loading in streams currently crossed by Route 460.

Indirect land use changes at some interchange areas would increase impervious surface area, with the potential to increase runoff and indirectly affect aquatic habitat. CBA 1 and CBA 3 would have comparable levels of indirect impacts to waters of the U.S and associated habitat as a result of indirect land use impacts. Indirect land use impacts are anticipated to impact 340 acres with CBA 1 and 380 acres with CBA 3. The increased impervious surface associated with the land use changes are analyzed in the cumulative impacts section on water quality section 15.4.3. Wetland impacts in these development areas would be expected to be minimal due to the avoidance and minimization requirements of wetland regulations as well as the ample availability of non-jurisdictional developable land. CBA 2 would impact fewer acres (50) as a result of induced development, but the same results with regard to indirect impact minimization would occur with CBA 2 as were described for CBAs 1 and 3.

9.0 INDIRECT IMPACTS TO WATER QUALITY FROM INDIRECT LAND USE CHANGES

Indirect impacts to water quality beyond those discussed in the preceding section could occur as a result of the increases in impervious surface from development that is induced by a project alternative. A quantitative analysis of impervious surface increases for direct and indirect project impacts as well as planned future actions is presented in Section 15.4.3 Cumulative Impacts. Findings are discussed in relative terms in this indirect impact discussion.

Individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) may require increases in impervious surface. Yet, these increases can be expected to be relatively minor in extent and severity.

CBA 1 and CBA 3 would have comparable levels of indirect impacts to water quality as a result of induced development. The increased impervious surface associated with induced development (94 acres and 128 acres of additional impervious surface, respectively) would increase stormwater runoff; however, certain design criteria associated with this development would be governed by VDEQ permits in that they would be required to follow best management practices (BMP) for stormwater retention and treatment and erosion/siltation control. CBA 2 would result in fewer acres (43 acres of impervious surface) as a result of induced development, but the same minimization of impacts through permitting requirements would be anticipated.

10.0 INDIRECT IMPACTS TO FLOODPLAINS

Development in floodplains is governed by federal and state statutes through the Virginia Department of Conservation and Recreation (VDCR) Floodplain Management Program and by local Flood Insurance Programs administered by localities and supervised by FEMA. For example, to be eligible for participation in federal flood insurance programs, cities, towns, and counties must adopt and enforce a development permitting process that prohibits development in floodways and alteration of the 100-year floodplain. The VDCR Floodplain Management Program and VDOT construction specifications for the roadway itself also address downstream floodplain and floodway effects.

If individual construction components associated with the No-Build and TSM Alternatives (such as turn lanes, shoulder widening, etc.) required encroachment within floodplains or regulated floodways, such encroachments can be expected to be relatively minor in extent and severity. Indirect impacts to floodplains and floodways would be negligible for all CBAs as a result of floodplain regulations and VDOT's bridge design standards. Regulatory restrictions and performance standards set forth in local floodplain ordinances and FEMA regulations would apply to induced development. In addition to mitigation measures designed to reduce the amount of floodplain encroachment by the CBAs, sections 107 and 103 of VDOT's highway construction specifications require implementation of stormwater management practices to address concerns such as post-development runoff associated with storm events and downstream channel capacity. These standards require that stormwater management facilities be designed to reduce stormwater flows to pre-construction conditions for up to a 10-year storm event. Also, during final design, a hydraulic study will be conducted that will ensure that no substantial increase in downstream flooding would occur.

11.0 INDIRECT IMPACTS TO THREATENED AND ENDANGERED SPECIES

Federally-listed threatened or endangered species in the study area include the bald eagle, the red-cockaded woodpecker, and the piping plover. Indirect impacts to these species could occur if the project's indirect land use impacts were anticipated to occur in the vicinity of these species' habitats. However, indirect land use impacts are limited to the areas around interchanges of the CBAs, and none of these species' habitats exist in these areas. Therefore, no indirect impacts to federally-listed threatened and endangered species are anticipated to occur with this project.

12.0 INDIRECT NOISE IMPACTS

Indirect land use impacts would change the patterns of traffic both on Route 460 and in adjacent activity areas. Indirect noise impacts could occur where new activity areas are created, if the nature or intensity of such areas were anticipated to add to local sound levels. According to the indirect land use impact analysis, the No-Build and TSM alternatives will not create any new activity areas. The new activity areas (i.e., commercial development) with the CBAs will be small in scale – no larger than 20 acres in size and consisting of gas stations, restaurants and small tourist-related businesses. The level of economic activity anticipated is directly related to the anticipated traffic levels of the CBA and cross-roads, which were considered in the direct noise impact analysis. Based on the indirect land use analysis, the type and scale businesses in new activity centers would not be expected to contribute substantially to increased noise in the interchange areas beyond that of the projected traffic.

13.0 INDIRECT AIR QUALITY IMPACTS

Regional air quality conformity analysis considers the projected increases in regional population and employment, which are included in the non-attainment regions' travel demand models. The two non-attainment regions are the Richmond-Petersburg region at the west end of the project and the Hampton Roads region at the east end of the project. The indirect land use impacts of the CBAs and any net increase in employment, with associated travel, would not necessarily be included in the regional air quality conformity analysis. However, the Route 460 location study is included in the conformity analysis for these regions, so the only incremental impact for air quality would be the indirect land use changes. The majority of CBA land use impacts occur at the ends of the project that are within these non-attainment areas. This includes 300 acres of low-density residential development in Prince George County with CBAs 1 and 3, as well as 20-30 acres of commercial development at the eastern end of the project with all three CBAs. These impacts are insignificant when one considers that the Richmond-Petersburg region has a population of approximately one million and the Hampton Roads region has approximately 750,000 jobs. The minute proportion of regional development that would be increased by the project's indirect land use impacts is not anticipated to affect air quality conformity in either non-attainment region.

14.0 INDIRECT IMPACTS TO CULTURAL RESOURCES

Unlike streams and jurisdictional lands (i.e. wetlands), cultural resources may be encroached upon or displaced, through private land transactions, where indirect land use impacts occur. Thus, the indirect impact analysis to cultural resources focuses on the presence of National Register listed or eligible sites in the areas where induced development is anticipated to occur.

- CBA 1 – The interchange with Route 620 south of Wakefield is anticipated to have 10 acres of commercial development. This is in the vicinity of the Wakefield Sportsmen's Club (DHR 091-5058). This is the location of the annual "Shad Planking" political event.
- CBA 2 – At the Isle of Wight County/Suffolk City line, 10 acres of commercial development are anticipated to be induced by a new interchange. This is in the vicinity of Saunders House (DHR 046-0006).
- CBA 3 – The interchange noted for CBA 2 is also part of CBA 3. In addition, at the new interchange on Route 620 north of Ivor is anticipated to have 10 acres of induced commercial development, Oak Grove (DHR 087-0014) is located in the vicinity of this interchange.

The potential impact areas are one-mile in radius around the CBA interchanges. GIS analysis indicates that ample developable land is available for the 10 acres of development anticipated at these sites without encroaching upon the historic sites. Also, this development would require site plan approval from local government, and effects to historic properties could be considered during this process. The decisions of landowners will also factor into preservation of these historic sites.

15.0 CUMULATIVE IMPACTS

15.1 ASSUMPTIONS

In accordance with CEQ guidance, the cumulative effects analysis was limited through the NEPA scoping process to effects that can be evaluated meaningfully and that are of concern to resource agencies, local officials, and/or the public. Comments and discussion from Citizen Information Meetings, Study Team meetings, project presentations to local municipalities and interest groups (i.e., the Nature Conservancy), and individual phone calls and/or meetings held with resource agencies and local entities were used by the project team to help define the issues of importance and the appropriate level of analysis. The project team also relied on the information available through the project's technical evaluations to determine the need for and focus of evaluations for cumulative effects. A review of past actions also revealed issues of concern.

Based on this process, issues of concern evaluated in the cumulative effects analysis are assumed to be:

- Impacts to farmlands;
- Economic impacts to communities;
- Impacts to water quality and aquatic habitat;
- Impacts to forested lands, affecting terrestrial communities and habitat; and
- Impacts to wetlands

15.2 EVALUATION METHODS

Trend analyses presented in the *Natural Resources Technical Report*, the *Land Use, Farmland and Park Lands Technical Report*, and the *Socioeconomic Technical Report* provide a baseline condition for the cumulative analysis. The existing and future No-Build land use scenarios assumed for this project are considered the cumulative baseline condition and include other major future actions, growth trends, and the influence of infrastructure and market pressures on development. The direct and indirect impacts of the proposed CBAs, when added to impacts of other past, present, or future actions, were assessed to identify the cumulative effects to resources of concern and the incremental impact of the proposed project. Cumulative project impacts were quantified in GIS or qualitatively discussed for each issue of concern.

Evaluation of cumulative impacts was completed in the following steps:

1. Identify past, present, and reasonably foreseeable future actions. These actions were noted in local comprehensive plans and through discussions with local governments and agencies.
2. Establish the spatial boundaries or geographic limits of the cumulative analysis for each resource of concern. For socioeconomic resources, the county and city boundaries of Prince George, Sussex, Surry, Southampton, Isle of Wight, and Suffolk comprised the geographic limits. For natural resources, study area portions of four watersheds comprised the geographic limits.
3. Team members then reviewed the long-term productivity or sustainability of resources potentially affected by the Route 460 project and other planned actions to identify the incremental effects of the proposed project.

Specific methods used to analyze each resource are discussed in the respective sections of the cumulative impact analysis. Generally, they include literature review, local coordination, analysis of traffic

data, GIS analysis, and application of empirically-based ratios and thresholds. Statistical trend analysis was not necessary for the analysis of cumulative impacts given the issues of concern that were identified by resource agencies and the impact of changing regulations over time to the degradation/preservation of those resources. Establishment of specific historic timeframes for the analysis was therefore not essential. For example, forested habitat has generally decreased over the past 200 years, but the cumulative impact analysis for this resource looks at the overall ratio of forested habitat now, in the future without the CBAs, and in the future with the CBAs.

15.3 PAST AND PRESENT ACTIONS

Past and present actions affecting the resources, ecosystems, and human communities of concern include:

Period: 1900 – 1950s

- Towns of Windsor and Wakefield incorporated – 1902
- Development of large-scale agricultural processing industries based on peanuts, pork processing, and paper products (e.g., Smithfield Foods -1936, Union Camp/International Paper - 1937, Planters Peanuts – 1906.)
- Development of Fort Lee in Prince George County – 1917 – quartermaster and logistics training disciplines.
- Development of I-64 – From Hampton Roads to Richmond, completed between 1957 and 1968
- Development of I-95 – 1958

Period: 1960 – 1980s

- Development of Surry Nuclear Power plant (Virginia Electric and Power Company (VEPCO) – now Dominion Power) – 1973
- City of Suffolk merged with Nansemond County - 1974
- Norfolk Southern ceased passenger rail service between Petersburg and Suffolk in the early 1970's
- Food Lion distribution Center – Prince George

Period: 1990 - Present

- Development of I-295 in Prince George – 1992
- Development of I-664 in Suffolk – Construction started 1979 and ended in 1992 with completion of the Monitor-Merrimack Memorial Bridge-Tunnel.
- Atlantic Waste Landfill – Sussex County – Permitted in 1993 (landfill expected to be full in 2006)
- Sussex I and II State Prisons – over 2,400 prisoners, security levels 4 and 5, opened 1998-1999
- Preservation of Piney Grove Preserve (Nature Conservancy) – 1998. Piney Grove harbors Virginia's last breeding population of red-cockaded woodpeckers.
- Development of Prince George's SouthPoint Industrial Park – 2000 - ongoing
- Boundary adjustment to the Town of Windsor, increasing land area from 653 acres to 2,578 acres July 2001.
- Hurricane Isabel – September 2003

15.4 OTHER MAJOR FUTURE ACTIONS:

Through review of existing plans and coordination activities, major planned actions in or affecting the study area were identified. Most of the development information was provided by local planning and economic development officials. Table 15.4-1, Table 15.4-2, and Table 15.4-3 show the major, future actions and the location and timing of these actions. Table 15.4-1 identifies transportation projects, Table 15.4-2 presents commercial development and Table 15.4-3 presents residential development. All of the developments in Table 15.4-2 and Table 15.4-3 were considered in the cumulative impact analysis as reasonably foreseeable future development that will occur with or without the proposed improvements to Route 460. The projects in Table 15.4-1 were evaluated with regard to planning status and were not found to be reasonably foreseeable for the reasons described in the table. The developments in Table 15.4-2 and Table 15.4-3 are presented graphically in Figure 15.4-1 by the numbers indicated in the left-hand column of each table.

Table 15.4-1
FUTURE MAJOR TRANSPORTATION PROJECTS

Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
Route 258 Bypass	VDOT	Isle of Wight County	Identified as a needed, long-term roadway improvement in county's comprehensive plan. However, it is not included in VDOT's 6-Year Transportation Improvement Plan nor is it included in the Hampton Roads PDC's 2030 Constrained Long-Range Plan. As such, it is not incorporated in this cumulative analysis.
Passenger Rail	VDRPT	Richmond – Hampton Roads	Richmond/Hampton Roads Passenger Rail Study pending. Members of the Route 460 Study Team have been involved in the study. As a preferred alternative has not been selected, this project is not incorporated in this cumulative analysis. None of the alternatives, however, would make a discernable difference to the traffic forecasts for the CBAs.
Eastern Virginia Airport	Virginia Department of Aviation	Surry, Isle of Wight, or Suffolk	Virginia Department of Aviation was investigating the possibility of constructing a regional super airport or additional airport in one of these localities. The final Eastern Virginia Airport System Study (EVASS) was released in July 2001 and identified the potential for the creation of a new Air Carrier Airport that would be constructed in Isle of Wight County and available for use in approximately 2032. However, this new airport is not included in the Department of Aviation's long-range plan. Therefore, this project is not incorporated in this cumulative analysis.

Source: Michael Baker Jr., Inc. 2005

Table 15.4-2
FUTURE MAJOR COMMERCIAL DEVELOPMENT ACTIONS

No.	Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
1	New container terminal	A.P. Moller / Maersk Group (APM Terminals North America, Inc.)	Portsmouth on the west side of the Elizabeth River.	Anticipated completion 2007
2	New container terminal	Port of Virginia	East side of Craney Island in Portsmouth.	EIS pending – due December 2005. Located outside the study area, this facility is not incorporated in the resource-based cumulative analysis. However, projected increases in port activity are included in the traffic analysis for this EIS. The Port Authority is proposing more than \$334.8 million in significant improvements to existing facilities and construction of new facilities to accommodate the more than 16 million tons of general cargo forecasted for Virginia Ports by the year 2010. The Port Authority anticipates the creation of 54,255 jobs annually with total annual wages of \$1.7 billion annually and the generation of an additional \$155 million per year in state and local taxes.
3	New Intermodal Facility – Norfolk Southern South Central Virginia Intermodal Terminal	Norfolk Southern Railroad	New Bohemia, Prince George County	Shipping/warehouse development on approximately 22 acres bounded by Lamore Drive, Norfolk Southern railroad tracks. Facility is anticipated to serve 200 trucks per day in the first phase and, if successful, expanding the complex to accommodate approximately 500 trucks daily. It is expected to generate approximately \$65,000 annually in tax revenues. If distribution warehouses are allowed, an additional \$600,000 annually would be generated in tax revenues
4	Development of Norfolk Southern property	Norfolk Southern Railroad / Isle of Wight County	East and west of Windsor in Isle of Wight County	Norfolk Southern property east of Windsor is 1,600-acre undeveloped tract; one of largest tracts on East Coast. Very desirable property since the tract has rail access and is reasonably accessible to ports. It is assumed to be developed as an inland port facility with multimodal industrial park by 2026 with an anticipated 5,600 jobs created (assumes all jobs are automated and that it is all warehouse type of development). In addition, Isle of Wight owns approximately 400 acres in the area for industrial development adjacent to the existing Shirley T. Holland Industrial Park.

No.	Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
5	Southpoint Industrial Park – Build-out	Private Developers and Prince George County	Prince George County, adjacent to I-295 and Route 460	1,800 acre industrial park for light manufacturing and distribution. Anticipate build-out in 5 to 10 years.
6	Moving Southside Regional Medical Center to Reves Road	Petersburg Hospital Company, LLC	Prince George County	Plans to relocate Southside Regional Medical Center and add two operating rooms. The current facility is a 408-bed acute care medical center with two professional schools.
7	Five Forks Energy Power Plant	Dominion Virginia Power	Sussex County, along Norfolk Southern rail line, on the north side of Route 602 and south of Route 460	Potential location of a cogeneration power plant. Size of parcel approximately 1,000 acres. If cogeneration power plant is not developed, this site remains a prime location for other industrial development due to rail access.
8	Regional Industrial Park	Town of Waverly and Sussex County	Old Waverly Airport along Route 460	Proposed industrial park on approximately 171 acres.
9	Expansion of the Town of Wakefield	Town of Wakefield	West of town along Route 460	Annexation of land planned in next 2-3 years
10	Strip Shopping Center	Private	Windsor, between railroad tracks and Route 460	Proposed 30,000 square feet retail and fast food restaurant with 15 to 20 commercial units and a fast food establishment. Total area approximately 2.5 acres
11	Retail Development	Private	Windsor, along Route 460 near Food Lion	Proposed commercial development on 21 acres with 50,000 square feet of retail space.

Source: Michael Baker Jr., Inc. 2005

**Table 15.4-3
FUTURE MAJOR COMMUNITY AND RESIDENTIAL DEVELOPMENT**

No.	Action	Agency/ Owner/ Manager	Location	Timing and/or Description of Action*
12	Church	Private	Windsor	10-acre site for new church
13	Single Family Residential	Private	Windsor	Second phase of Windsor Woods Subdivision. Additional 52 units to be built.
14	Single Family Residential	Private	Windsor, along Route 603	Proposed Holland Meadows subdivision with 100-units.
15	Single Family Residential	Private	Isle of Wight County near Route 460 and the Cost Plus Distribution Center	Proposed 200 unit subdivision (1 unit per 5 acres). Total acreage likely to be 1,000 acres
16	Single Family Residential	Private	Prince George County near Route 156	Lamar Drive subdivision with 24 units.
17	Single Family Residential	Private	Prince George County near Route 625 north of Route 460	60 acre parcel (12 units on 5 acres each) Arwood Road. 125 acre Warwick Acres (24 lots at 5 acres each)
18	Single Family Residential	Private	Prince George County near Route 625 south of Route 460	500 acre parcel (150 units) for residential development.
19	Single Family Residential	Private	Prince George County along Route 611	235 acre Pleasant Grove Estates (47 lots at 5 acres each)
20	Single Family Residential	Private	City of Suffolk, Kings Fork Road to Route 460	382 units at Kings Fork Farms (approximately 400 acres)
21	Expansion of Retirement Community	Private	City of Suffolk, near Lake Prince	Lake Prince Retirement Community expanding with additional 60 to 70 residential lots (approximately 70 acres)
22	Single Family Residential	Private	Sussex County, along Route 40	Waverly Meadows Subdivision on approximately 18 acres (70 units on ¼ acre lots)
23	Single Family Residential	Private	Sussex County, along Route 617	3 acre development with 10 units on ¼ acre lots
24	Single Family Residential	Private	Sussex County, along Route 628	Drumwright Mill Subdivision. 500 lot subdivision with lot size varying from ¼ to 5 acres. Planned urban development (PUD) with golf course.
25	Single Family Residential	Private	Prince George County, along Routes 635 & 636	24 units at Centenial Acres 24 units at Centenial/Lawyers Road

Source: Michael Baker Jr., Inc. 2005

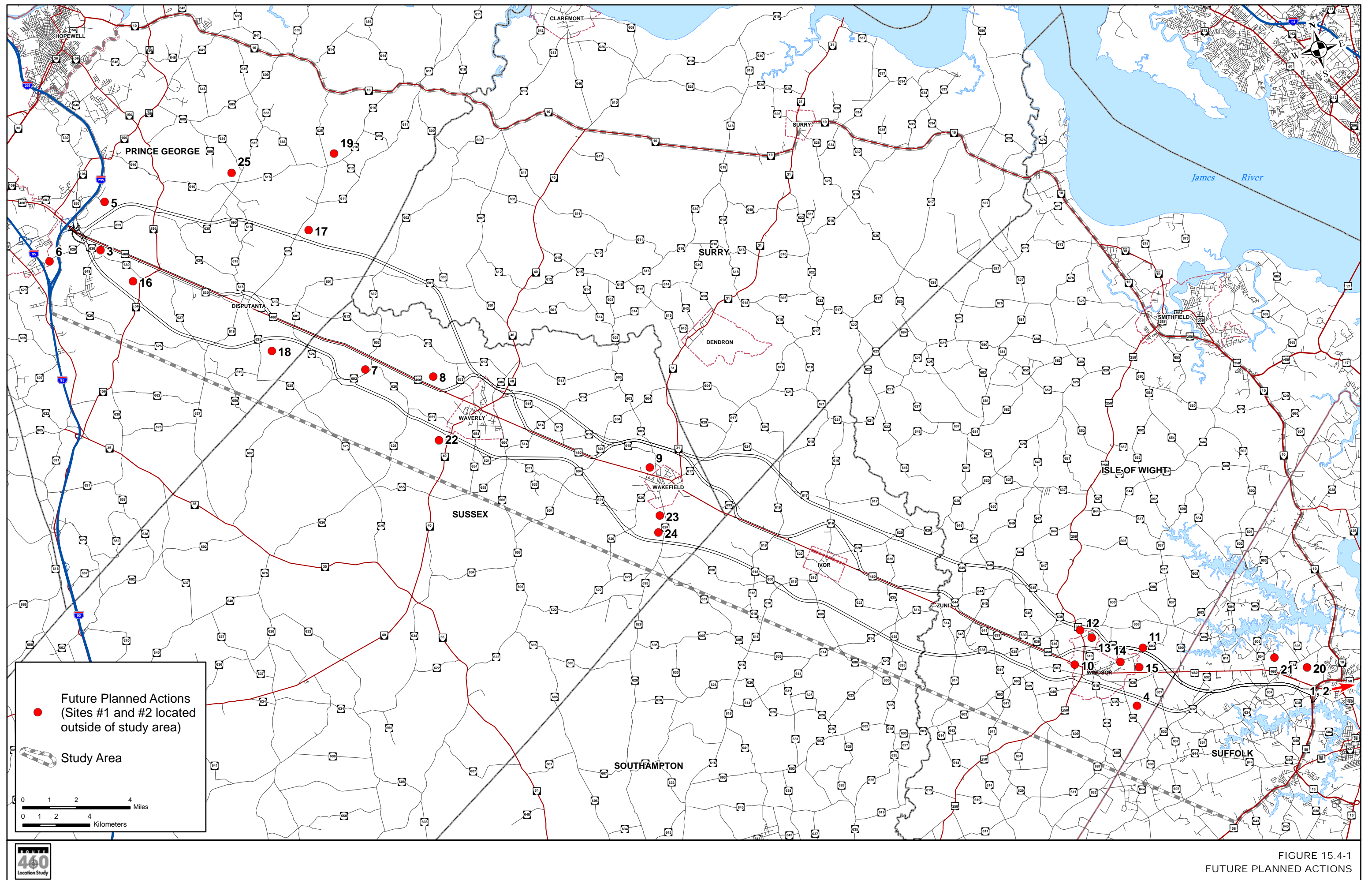


FIGURE 15.4-1
 FUTURE PLANNED ACTIONS

15.4.1 Cumulative Impacts to Farmlands

Assumptions and Evaluation Methods

Cumulative impacts to agricultural lands may result from the conversion of agricultural lands due to the proposed project, induced development, and private actions. Where indirect land use changes occur, several factors are perceived as contributing to pressures for development and the resulting pattern of development. Planning regulations are a primary factor. Other factors include regional economies, housing preference toward larger lots, and the provision of water, sewer, and transportation infrastructure. Although new transportation facilities alone cannot result in land use changes without the other factors in place, when these other factors exist, transportation facilities can contribute to development pressures if they provide new access or offer travel time savings.

The indirect land use analysis assumes that induced development associated with the CBAs would convert agricultural or forestland uses to developed uses. The amount of agricultural land use conversion versus forestland conversion depends on its location and availability within each interchange area. It was assumed that agricultural land uses were slightly more attractive as potential development locations than forestland uses.

Of the jurisdictions in the study area, growth management provisions to regulate land use changes and preserve agricultural uses are evident in the Comprehensive Plans of Isle of Wight County and the City of Suffolk. Three separate Agricultural and Forestal Districts have been established in Isle of Wight County to protect and preserve agricultural industry and the county's rural character while strengthening and enhancing the economic viability of agricultural industry. In addition, the county has implemented strict growth management policies based on a "contained growth" strategy and has a rural economic development manager on staff to support local agribusiness. The City of Suffolk has adopted a growth management policy based on balanced growth, responsible regionalism, environmental protection, rural character preservation, core area revitalization, and enhancement of economic vitality. As the city's Comprehensive Plan states, "Development to the northwest [including the area surrounding Route 460] will be significantly lower in intensity, with emphasis on large lot homes with public water and septic systems. This is a change from current City policies. This low intensity development will occur between the two urbanized areas as well so as to avoid a continuous mass of development along major transportation corridors". In other words, the city's plans and policies are focused, in part, on preserving agricultural lands.

The cumulative impacts to farmlands will occur as a result of 1) direct project impacts, 2) the project's indirect land use impacts in interchange areas, and 3) other planned actions. Cumulative impacts cannot be directly estimated for actively farmed parcels due to lack of GIS information. However, impacts to land classified as agricultural serves as a proxy. This classification includes cropland and pasture, confined feeding operations and "other" agricultural land.

A GIS analysis of the location of agricultural land uses and agricultural/forestal districts was compared to the location of induced development identified in Section 3.3.2. As discussed in this section, each 2,000-acre interchange area was reviewed for the amount and type of developable land outside of agricultural and forestal districts. Anticipated land use changes were allocated to available land based on the assumption that, accessible, agricultural land would develop first, followed by accessible forested non-wetland acres. In every case, these two land types were more than sufficient to absorb the projected development. For the other planned actions, many of the sites are not identified at a parcel level or within large parcels, so a worst-case scenario of forestland impacts was assessed.

Reasonably foreseeable future actions within the study area from Table 15.4-2 and Table 15.4-3 were reviewed, and wherever possible, acres were estimated for the development. Actual sites were identified where possible and general locations were used, based on the same assumptions as the interchange area analysis, to analyze impacts to farmland.

Cumulative Farmland Impacts

Based on the land use impact analysis in the *Land Use, Parklands, and Farmlands Technical Report*, 30.4 percent of the study area (144,671 acres) is in agricultural land use. Historically, the study area has been predominantly rural, and while some residential and industrial developments have reduced the agricultural land in the study area, these developments are small in number and generally small in scale. The future No Build scenario, or baseline, for farmland impacts includes the impacts of planned actions, including industrial, commercial and residential development. The analysis accounted for all planned developments within the study area. These planned actions are estimated to consume an additional 8,600 acres of land in a worst-case scenario. If all of this land were agricultural, that would consume six percent of the agricultural land in the study area.

As noted in Table 15.4-4, direct agricultural land use impacts range from the conversion of 517 acres to 707 acres in the Design Corridor of the CBAs. Indirect land use changes to agricultural land uses are estimated to result in the conversion of an additional 115 acres with CBA 1, 30 acres with CBA 2, and 150 acres with CBA 3. Total direct and indirect impacts would account for less than 0.5 percent of total agricultural land uses in the study area with the Design Corridors of CBAs 1 and 2 and less than 0.6 percent with the Design Corridor of CBA 3.

Thus, the project-related impacts to agricultural land are estimated to consume up to one percent of agricultural land, and the worst case scenario for total cumulative effects to agricultural land is estimated to be less than seven percent of all agricultural land. Given the scale of these impacts, cumulative impacts to this resource do not appear to be sufficiently extensive to threaten its sustainability.

Table 15.4-4
DIRECT AND INDIRECT FARMLAND IMPACTS

Alternative		Direct Agricultural Impacts (acres)	Indirect Agricultural Impacts (acres)	Total Direct and Indirect Agricultural Impacts (acres)	Percent of Agricultural Land in Study Area
CBA 1	Planning Corridor	965	115	1,080	0.75%
	Design Corridor	517	115	632	0.44%
CBA 2	Planning Corridor	1237	30	1,267	0.88%
	Design Corridor	557	30	587	0.41%
CBA 3	Planning Corridor	1229	150	1,379	0.95%
	Design Corridor	707	150	857	0.59%

Source: Parsons Brinckerhoff and Michael Baker Jr. 2005

15.4.2 Cumulative Economic Impacts to Communities

Economic conditions in the study area vary according to locality – past and present actions include economic growth and isolated economic decline. The future economic setting without the proposed project would include economic growth at planned industrial parks and at port terminals. This growth brings more jobs to study area residents, but also would add truck traffic to the existing Route 460 facility, exacerbating concerns such as safety and local pedestrian movement that pose difficulties for local business districts. Other economic forces in the study area include the trend towards “big box” retail which, while not evident within most of the study corridor today, nevertheless threatens local business

districts from the locations where this development does occur at the east and west ends of the study area and beyond. The economic future for study area communities is therefore a mixture of good and bad without the proposed improvements to Route 460.

Table 15.4-5, Table 15.4-6, and Table 15.4-7 that follow present the collective economic impact findings from direct and indirect impacts of the CBAs. The direct impacts are explained in detail in the Right of Way and Relocation Technical Report and the Socioeconomic Technical Report. These findings show that negative direct impacts in the form of job losses and lost property tax revenues will generally be offset with indirect impacts from commercial growth at interchange areas and enhanced attractiveness to planned industrial areas as a result of travel time savings. A concern voiced by communities along the corridor, however, is the continued sustainability of existing downtown areas once they are bypassed. This issue is addressed in Section 5.0 Indirect Economic Impacts, and the analysis finds that the bypass effects also have both positive and negative impacts to communities. The opportunity created by the reduction in traffic in business districts and the proximity to the improved Route 460 interchanges can actually enhance the economic sustainability of the towns.

From a cumulative standpoint, the communities will face economic challenges with or without the proposed improvements to Route 460. The opportunity for economic benefits appears greater with the CBAs, however, because of the travel time savings to industries and the potential for bypassed communities to create more attractive and sustainable downtown business districts than would be possible if truck traffic remained on the existing route.

Table 15.4-5
ESTIMATED ECONOMIC EFFECTS OF CBA 1

Locality	Direct Employment Lost¹	Direct Loss of Property Tax Revenues¹	Location and Degree of Induced Commercial Development²	Existing and Planned Industrial Areas Benefiting from Improved Accessibility
Prince George County	10 jobs	\$32,762	No commercial development anticipated, but induced residential development would occur at Route 156	<ul style="list-style-type: none"> • Southpoint Industrial Park • Planned Norfolk Southern facility
Sussex County	0	\$9,150	Potential for light tourist / commercial services at the interchange areas in Waverly and Wakefield	<ul style="list-style-type: none"> • Existing and planned industrial development along Route 602 • Town of Waverly's industrial area on Route 40
Surry County	0	\$0	None anticipated	None anticipated
Southampton County	0	\$2,608	None anticipated	None anticipated
Isle of Wight	0	\$22,993	None anticipated	<ul style="list-style-type: none"> • Town of Wakefield's industrial zoned area on Route 258
City of Suffolk	0	\$13,182	Potential for economically competitive development at Route 58 Bypass area	None anticipated
Total	10 jobs	\$80,695	Three locations of induced commercial development	Five industrial areas with improved access

¹Design Corridor estimates are shown for comparison purposes

²Table 3.3-1

Source: Michael Baker Jr., 2005

**Table 15.4-6:
ESTIMATED ECONOMIC EFFECTS OF CBA 2**

Locality	Direct Employment Lost¹	Direct Loss of Property Tax Revenues¹	Location and Degree of Induced Commercial Development²	Existing and Planned Industrial Areas Benefiting from Improved Accessibility
Prince George County	80 jobs	\$32,294	None anticipated	<ul style="list-style-type: none"> • Southpoint Industrial Park • Planned Norfolk Southern facility
Sussex County	<10	\$7,177	Potential for light tourist / commercial services at the interchange area in Waverly	<ul style="list-style-type: none"> • Planned Regional Industrial Park (airport site)
Surry County	0	\$445	None anticipated	None anticipated
Southampton County	<10	\$7,502	Potential for light tourist / commercial services at the interchange area in Ivor	None anticipated
Isle of Wight	15	\$26,933	Potential for light tourist / commercial services at the interchange area east of Windsor	<ul style="list-style-type: none"> • Shirley T. Holland Industrial Park • Planned development of Norfolk Southern parcel (1,600 acres)
City of Suffolk	0	\$18,063	Potential for economically competitive development at Route 58 Bypass area	None anticipated
Total	115 jobs	\$92,414	Four locations of induced commercial development	Five industrial areas with improved access

¹Design Corridor estimates are shown for comparison purposes

²Table 3.3-1

Source: Michael Baker Jr., 2005

**Table 15.4-7:
ESTIMATED ECONOMIC EFFECTS OF CBA 3**

Locality	Direct Employment Lost¹	Direct Loss of Property Tax Revenues¹	Location and Degree of Induced Commercial Development²	Existing and Planned Industrial Areas Benefiting from Improved Accessibility
Prince George County	0	\$16,971	No commercial development anticipated, but induced residential development would occur at Route 156	<ul style="list-style-type: none"> Planned Norfolk Southern facility
Sussex County	0	\$3,515	Potential for light tourist / commercial services at the interchange areas in Waverly and Wakefield	None anticipated
Surry County	0	\$2,756	None anticipated	None anticipated
Southampton County	0	\$3,023	Potential for light tourist / commercial services at the interchange area in Ivor	None anticipated
Isle of Wight	0	\$13,101	Potential for economically competitive development on Route 258 in Windsor Potential for light tourist / commercial services at the interchange area east of Windsor	<ul style="list-style-type: none"> Shirley T. Holland Industrial Park Planned development of Norfolk Southern parcel (1,600 acres)
City of Suffolk	0	\$18,063	Potential for economically competitive development at Route 58 Bypass area	None anticipated
Total	0	\$57,430	Five locations of induced commercial development	Three industrial areas with improved access

¹Design Corridor estimates are shown for comparison purposes

²Table 3.3-1

Source: Michael Baker Jr., 2005

15.4.3 Cumulative Impacts to Water Quality and Aquatic Habitat

Assumptions and Evaluation Methods

Due to its very nature, assessing cumulative impacts to water quality and aquatic habitat is a complex and highly speculative undertaking. Notwithstanding, this analysis focuses on an important variable related to water quality that can be assessed using the methods described below—impervious surface. Increases in impervious surface relative to natural areas in the study area is assumed to be an indicator of cumulative impacts to water quality.

Increases in impervious surfaces resulting from development can affect the physical and chemical characteristics of streams, potentially altering aquatic habitat. If not effectively attenuated through use of BMPs, increases in impervious surface can increase runoff volume, which in turn can lead to erosion, stream widening, and incision, as well as increased contributions of pollutants (particularly sediment) to surface waters. Increases in concentrations of these pollutants in surface water can result in disruption of life processes for aquatic organisms, can be toxic to aquatic life, or can decrease habitat suitability.

According to empirical research, when impervious surface cover exceeds 10 percent within a given watershed, negative effects on in-stream habitat are typically observed; at 25 percent, the watershed becomes severely degraded (Center for Watershed Protection, 2003). These thresholds are based on areas where much of the development occurred before existing stormwater management practices were in place. Therefore, these thresholds would be higher in areas developed using these practices

While the study area appears to be below the 10 percent threshold based on analysis that follows, it is nevertheless the case that past actions have caused extensive degradation of water quality in the study area. As detailed in the *Water Quality Technical Report*, extensive portions of the Blackwater River and numerous aquatic systems in the study area are considered impaired on the basis of fecal coliform, sediments, and other pollutants. These impairments are related to agricultural runoff, intensive livestock operations, and sanitation-related issues rather than impervious surfaces based on the extent of fecal coliform impairments. However, the amount of impaired waters in the study area suggests that stormwater management for any amount of development will be important to the future water quality in the study area.

The anticipated levels of impervious surface associated with each of the CBAs and other major actions were compared to existing impervious surface within the study area to assess the potential for cumulative impacts to water quality and aquatic resources. Impervious surface cover was based on a GIS analysis of existing land use data from the National Land Cover Dataset of the portion of each watershed in the study area. Built land uses (e.g., commercial, industrial, other, and residential) were assigned an impervious surface ratio based on industry planning standards.

Cumulative Water Quality and Aquatic Habitat Impacts

In existing conditions, natural areas represented between 92 to 100 percent of the four watersheds. This demonstrates the vastness of natural land uses relative to the built environment. Based on this analysis noted in Table 15.4-8, negative impacts to stream habitat are not anticipated in existing conditions due to the level of impervious surface within each watershed. However, as noted above, there are extensive portions of the Blackwater River and numerous swamps that currently are impaired waters for a variety of reasons.

Reasonably foreseeable future actions within the study area identified in Table 15.4-2 and Table 15.4-3 were disaggregated according to watershed. Acres were estimated for the development and assigned a ratio of impervious surface based on planned land use. These other planned actions are estimated to consume an additional 8,600 acres of land resulting in an addition of approximately 2,300 acres of impervious surface in the Blackwater River watershed, 1,900 acres in the Nansemond River watershed, and 400 acres in the Nottoway River watershed. No major projects were identified for the Lower James

River watershed within the study area. All of these watersheds would have less than 10 percent impervious surfaces within the planned future developments (Table 15.4-8). Thus, the future baseline condition without the proposed Route 460 improvements would fall below the most conservative threshold that indicates degradation of aquatic habitat. However, the waters impaired by pollutants in the current condition would be sensitive to any development impacts. The permitting process discussed in the indirect impact analysis in Sections 8.0 and 9.0 serve to protect the receiving waters from any further impairment since new discharges are permitted and monitored considering ambient water quality standards.

As noted in Table 15.4-9, all three CBAs have similar direct and indirect impacts to water quality on the basis of the levels of impervious surface in the Blackwater River and Nansemond River watersheds. As CBA 1 is the only alternative to affect the Nottoway River watershed, it is the only one to result in impervious surface changes in that watershed. The direct and indirect impacts of CBA 1 increase the percent of impervious coverage from 0.9 percent to 1.3 percent in the Blackwater River watershed, from 2.5 percent to 3.0 percent in the Nansemond River watershed, and from 0.2 percent to 1.4 percent in the Nottoway River Watershed. The direct and indirect impacts of CBA 2 increase the percent of impervious coverage from 0.9 percent to 1.2 percent in the Blackwater River watershed and from 2.5 percent to 3.1 percent in the Nansemond River watershed. The direct and indirect impacts of CBA 3 increase the percent of impervious coverage from 0.9 percent to 1.4 percent in the Blackwater River watershed and from 2.5 percent to 3.0 percent in the Nansemond River watershed.

As noted in Table 15.4-10, the direct and indirect impacts of each CBA in addition to the land use conversions associated with other major actions would result in similar changes to impervious surface in the Lower James River, Blackwater River, and Nansemond River watershed. As previously noted, CBA 1 is the only alternative to affect the Nottoway River watershed and results in higher cumulative changes to impervious surface area when compared to CBAs 2 and 3.

Increased impervious surfaces does not, necessarily translate into worse water quality in receiving waters when appropriate best management practices are employed. As noted in the *Water Quality Technical Report* and *Natural Resources Technical Report*, with implementation of appropriate mitigation measures and best management practices (BMPs), the construction and operation of a CBA is not expected to result in measurable degradation of water quality or affect changes to regional water quality. The cumulative amounts of impervious surface in all three CBAs are well below the threshold of 10 percent and, as such, no negative cumulative effects to aquatic habitat are anticipated.

Table 15.4-8
EXISTING AND FUTURE PLANNED IMPERVIOUS SURFACE COVERAGE IN THE STUDY AREA BY WATERSHED

		Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
Existing	Acres	514	2,703	1,626	16
	Percent in study area	0.5%	0.9%	2.5%	0.2%
Planned	Acres	0	2,300	1,900	400
	Percent in study area	0	0.7%	2.9%	3.9%

Source: Michael Baker Jr., 2005.

Table 15.4-9
DIRECT AND INDIRECT IMPACTS TO IMPERVIOUS SURFACE COVERAGE IN THE STUDY AREA
BY WATERSHED

		Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
CBA 1	Acres	0	1,333	307	125
	Percent in study area	0%	0.4%	0.5%	1.2%
CBA 2	Acres	0	898	367	0
	Percent in study area	0 %	0.3%	0.6%	0.0%
CBA 3	Acres	0	1,510	293	0
	Percent in study area	0%	0.5%	0.5%	0.0%

Source: Michael Baker Jr., 2005.

Table 15.4-10
CUMULATIVE IMPACTS TO IMPERVIOUS TO SURFACE COVERAGE IN THE STUDY AREA BY
WATERSHED

		Lower James River Watershed	Blackwater River Watershed	Nansemond River Watershed	Nottoway River Watershed
CBA 1	Acres	514	6,312	3,802	517
	Percent in study area	0.5%	2.0%	5.9%	5.0%
CBA 2	Acres	514	5,876	3,862	391
	Percent in study area	0.5%	1.9%	6.0%	3.8%
CBA 3	Acres	514	6,489	3,788	391
	Percent in study area	0.5%	2.1%	5.9%	3.8%

Source: Michael Baker Jr., 2005.

15.4.4 Cumulative Impacts to Terrestrial Communities and Habitat

Assumptions and Evaluation Methods

Forestlands are used as the primary indicator of terrestrial resource impacts to wildlife habitat. Forestland uses are discussed in detail in the *Land Use, Parklands, and Farmlands Technical Report* and terrestrial resources are discussed in the *Natural Resources Technical Report*.

The cumulative impacts to forestlands would occur as a result of 1) direct project impacts, 2) the project's indirect land use impacts in interchange areas, and 3) other planned actions. The analysis assumes that induced development associated with the CBAs and other planned actions that are not identified at the parcel level would convert agricultural or forestland uses to developed uses. The amount of agricultural land use conversion versus forestland conversion depends on its location and availability within each interchange area. It was assumed that agricultural lands were slightly more attractive as potential development locations than forestlands. Other planned actions are assumed to occur on developable land, which may include forested lands.

A GIS analysis of the location of forestland uses was compared to the location of induced development identified in Section 7.1. As discussed in Section 3.3, each 2,000-acre interchange area was reviewed for the amount and type of developable land. Anticipated land use changes were allocated to available land based on the assumption that accessible agricultural land would develop first, followed by accessible forested non-wetland acres. In every case, these two land types, outside of agricultural and forestal districts, were more than sufficient to absorb the projected development. However, specific parcels for development were not determined. For the other planned actions, many of the sites are not identified at a parcel level or within large parcels, so a worst-case scenario of forestland impacts was assessed.

Cumulative Terrestrial Communities and Habitat Impacts

The majority of the forestlands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, residential and commercial development. Based on the land use impact analysis in the *Land Use, Parklands, and Farmlands Technical Report*, 61.8 percent of the study area (294,671 acres) is in forestland use.

Reasonably foreseeable future actions within the study area from Table 15.4-2 and Table 15.4-3 were reviewed and acres were estimated for the development. These other planned actions, independent of the proposed project, are estimated to consume an additional 8,600 acres of land. If all of this land were forested, that would consume three percent of the total forestland in the study area. Because the forested areas are highly fragmented in the base condition, the areas most sensitive to habitat impacts are the riparian corridors that enable mobility and large contiguous forest tracts having a high rating for biodiversity. These areas are identified and discussed in the *Natural Resources Technical Report*. Comparing Figure 15.4-1 to the prominent wildlife corridors and the biodiversity-ranked communities, the areas that may be affected in the future baseline (No-Build) condition include development sites along Route 625 north of Disputanta (actions 17-19) and the Warwick Swamp area (action 7).

Table 15.4-11 shows the direct and indirect forest impacts. Direct forestland use impacts range from the conversion of 599 acres to 1,140 acres in the Design Corridor of the CBAs. Total direct and indirect impacts would account for less than 0.5 percent of total forestland uses in the study area with the Design Corridors of CBAs 1 and 3 and 0.2 percent with the Design Corridor of CBA 2. The project's direct and indirect impacts, at worst, would be 2,409 acres, which comprises 0.82 percent of the forestland in the study area (Planning Corridor of CBA 1). The Natural Resources Technical Report identifies the areas where direct impacts would occur in riparian corridors or key biodiversity areas, and the indirect impacts on these areas are discussed in Section 7.3.

In summary, the project-related impacts to forestland are estimated to consume up to one percent of forestland, and the worst case scenario for total cumulative effects to forestland is estimated to be less than four percent of all forestland. The majority of forested areas are not high quality with regard to species mobility and biodiversity and those sites known to be important for wildlife movement and biodiversity generally appear not to be at risk from cumulative impacts.

**Table 15.4-11
FOREST IMPACTS TO TERRESTRIAL NATURAL COMMUNITIES**

Alternative		Direct Forest Impacts	Indirect Forest Impacts	Total Direct and Indirect Forest Impacts	Percent of Forestland in Study Area
CBA 1	Planning Corridor	2,184	225	2,409	0.82%
	Design Corridor	1,140	225	1,365	0.46%
CBA 2	Planning Corridor	1,370	20	1,390	0.47%
	Design Corridor	599	20	619	0.21%
CBA 3	Planning Corridor	1,931	230	2,161	0.73%
	Design Corridor	998	230	1,228	0.42%

Source: Parsons Brinckerhoff and Michael Baker Jr.

15.4.5 Cumulative Impacts to Wetlands

Historically, the wetlands in the study area have been drained and filled extensively for agriculture and other land uses. Given that wetlands are widespread in the study area, specific site plans for future development were not available, and indirect land use impacts are only generally identified, a quantitative analysis of cumulative wetland impacts is not feasible. Instead, this section provides a qualitative assessment of cumulative wetland effects in light of current wetland regulations.

The regulatory processes governing wetlands are discussed in Section 8.1. Commercial and industrial development, as well as planned subdivision-style residential development, will be governed by these processes to prevent the loss of wetlands. Therefore, small-scale and individual lot residential development is the type of development that is most likely to cause unmitigated wetland impacts because the Corps permitting process is not required for such developments. In the future baseline or No-Build condition, these impacts will occur throughout the corridor, but are not expected to be widespread based on population growth forecasts of less than one-half percent per year in Southampton, Surry and Sussex counties and less than one percent per year in Prince George County. Chesapeake Bay regulations (adopted by each study area locality by ordinance) as well as separate Suffolk and Isle-of-Wight County land use regulations, incorporate additional measures to protect sensitive lands beyond that regulated strictly by VWPP and COE wetland permits.

In contrast to the general residential development that will occur in the baseline scenario, the indirect wetland impacts of the CBAs would be subject to regulations requiring avoidance, minimization, and mitigation of wetland impacts. Thus, the net future wetland impacts with and without the proposed action are assumed to be virtually the same and are not anticipated to threaten the sustainability or function of wetland systems in the study area.

SUPPORTING TABLES

Table 15.4-1
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 1

CBA 1 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Route 156 Prince George Co.	Forested and Agricultural Rural Residential	No Water / Sewer Available away from Route 460 Corridor Expansion of planned industrial use along the southern side of Route 460, bounded by Route 630. Designated Opportunity Zone (commercial and industrial use) north of Route 460 to Second Swamp. Planned residential and agricultural / open space use immediately around the CBA 1 interchange.	<p>PLANNED STAGE OF DEVELOPMENT: - Residential</p> <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT: Change in intensity and scale of planned land use but no change in type of planned land use. Likely to see increased pressure for conversion from Forested/Agricultural to Low to Medium Density Residential subdivisions. This area would likely become more attractive for residential use in the area of the interchange. 300 acres of induced residential development are assumed.</p> <p>Proximity to I-295 (3.25 miles) and Route 460 (1.6 miles), widening of Route 156 to four lanes north of Route 460, and industrial and commercial development in Petersburg and Hopewell, make this an attractive location</p> <p>The rate and intensity of residential development may increase. However, goods, services, and jobs would be easily accessible from this interchange; therefore, pressure to rezone to commercial or industrial uses would not be eminent. In addition, water and sewer are not currently available at this location.</p> <p>An Opportunity Zone (commercial and industrial development) at Route 156 and Route 460 is only 1.6 miles from the proposed interchange. This area could provide additional commercial services for this interchange area.</p>
Route 40 Waverly, Sussex Co.	Forested and Agricultural Residential Industrial	Water/sewer available along Route 40 in vicinity of interchange Area adjacent to CBA 1 interchange is zoned industrial Planned mobile home park and expansion of industrial area within vicinity of proposed interchange Planned expansion of residential land use on Route 40 south of Waverly town limit.	<p>PLANNED STAGE OF DEVELOPMENT: - Residential - Other Development</p> <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT: - Light Tourist / Commercial</p> <p>Slight to moderate change in type of land use. Given the proximity of the CBA 1 interchange to Route 460 in Waverly (1.5 miles) and the ADT on Route 40, it is likely that the area along Route 40, between the interchange and Route 460, will experience an infill of Light Tourist / Commercial Services (additional gas station/convenience store type of development). Ten acres of induced commercial development are assumed.</p> <p>Given the availability of water and sewer, improved access to Waverly via the CBA 1/Route 40 interchange, the area could also experience an increase in the rate and timing of planned residential and industrial development at this location</p>

Table 15.4-1
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 1 (Cont'd)

CBA 1 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Route 620 Wakefield, Sussex Co.	Forested and Agricultural Rural Residential	<p>No water/sewer available but county indicated willingness to extend these services to the interchange area.</p> <p>Planned Residential along secondary roads. A 500-lot residential planned community, Drumwright Mill Subdivision, is planned along Route 628, south of Route 460.</p> <p>Planned Agricultural / Open Space, adjacent to residential areas</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Residential <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Light Tourist / Commercial <p>Slight to moderate change in type of land use. Given the distance (2.8 miles) from the CBA 1 interchange at Route 620 to Route 460 in Wakefield, and the county's willingness to provide water and sewer, it is likely that the area around the interchange will experience pressure to rezone. Likely development could include gas station / convenience store and/or fast food restaurant. Ten acres of induced commercial development are assumed. This would compliment the service needs of the planned Drumwright Mill Subdivision.</p>
Route 58 Bypass Suffolk	Forested and Agricultural Residential Commercial Water (Lake Meade)	<p>Water/Sewer Available</p> <p>The City of Suffolk's Comprehensive Plan indicates that development to the northwest of the city (including the project area) will be significantly lower in intensity, with emphasis on large lot homes with public water and septic systems. This low intensity development will occur between two urbanized areas so as to avoid a continuous mass of development along major transportation corridors.</p> <p>Areas around Route 58 Bypass interchanges are designated as areas of Office Research and Development.</p> <p>Area immediately to the north of Route 460 and westward to Kings Fork, is designated for Suburban / Urban Development (with utilities)</p> <p>Due to its proximity to Lake Meade, the remaining area around the CBA 1 interchange is designated for Rural Conservation Area / Low Intensity Residential (with public water)</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Other Development - Economically Competitive <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Change in intensity and scale of planned land use but no change in type of land use. Given the city's current plans for development in this area, it is likely that more intensive development will occur at the CBA 1 interchange with the Route 58 Bypass. Additional commercial services (gas station, convenience store, fast food) may develop around the interchange in response to the demands of the existing and planned Commercial / Business / Office Park developments. Twenty acres of induced commercial development are assumed.</p>

Source: Michael Baker Jr., Inc., 2005

Table 15.4-2
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 2

CBA 2 Intersection Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Route 40 Waverly Sussex Co.	Forested and Agricultural Residential Commercial	<p>Water/sewer available</p> <p>In the vicinity of the proposed interchange, north of the town limits along the western side of Route 40, residential development is planned. Along the eastern side of Route 40, Agricultural / Open Space is planned.</p> <p>In the vicinity of the proposed interchange within the town limits, the area is currently developed for commercial use, primarily along the Route 460 corridor.</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Residential - Light Tourist / Commercial Services (along Route 460) <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Light Tourist / Commercial Services (at Route 40 interchange area) <p>Slight to moderate type of change in type of land use.</p> <p>Waverly officials indicated that the likelihood of the area around the CBA 2 interchange being rezoned to commercial or industrial would depend on what land owners wanted to do. Given the proximity of CBA 2 to Route 460 in Waverly (1 mile) and the availability of water and sewer, it is likely that this interchange area will experience pressure to develop Light Tourist / Commercial Services. Ten acres of induced commercial development are assumed.</p>
Route 620 Ivor, Southampton Co.	Forested and Agricultural Residential Commercial	<p>Water & Sewer along Route 460. Town of Ivor has municipal water but on septic system.</p> <p>Route 620 is a major commuter route to Smithfield.</p> <p>Planned land use around the Route 620 intersection area is a combination of Agricultural/Forested /Open/Rural Residential; Medium Density Residential, Commercial, and Industrial with the latter two being located along the Route 460 corridor. The county has indicated they would consider rezoning the interchange location to its fullest potential (commercial or industrial). Such rezoning would be consistent with local plans.</p> <p>Southampton County foresees heavy residential growth pressure from the Hampton Roads area. The proposed high-speed rail project and the proposed "super-airport" (Eastern Virginia Airport) could dramatically affect land use and development trends.</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Residential (along Route 620) - Light Tourist / Commercial Services (along Route 460) <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Slight to moderate change in type of land use.</p> <p>Given the county's desire to maximize the growth potential of interchanges and the traffic volumes on Route 620, both water and sewer would likely be extended to CBA 2 / Route 620 interchange area. This being the case, the interchange area would likely develop with Tourist / Commercial Services at the CBA 2 / Route 620 interchange. This might include a gas station or a convenience store. Ten acres of induced commercial development are assumed.</p>

Table 15.4-2: Potential Indirect Future Land Use Changes – CBA 2 (Cont'd)

CBA 2 Intersection Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Route 460 Isle of Wight Co. and Suffolk Line	Forested and Agricultural Rural Residential Commercial	<p>Water and Sewer Available</p> <p>Interchange within Windsor Development Service District to Isle of Wight / Suffolk line. This area is targeted for future growth and water and sewer facilities have been extended to accommodate growth.</p> <p>Planned Suburban Estate use along Route 460 corridor in Isle of Wight County</p> <p>Planned Conservation Development to the north and south of the Route 460 corridor in Suffolk.</p> <p>See discussion of CBA 2 – Route 258 for more detail concerning land use within Windsor.</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Minimal Development (in Suffolk) - Residential (Isle of Wight) <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Light Tourist / Commercial Services. Complete change in type of planned land use, as well as rate and scale of development in Isle of Wight portion of interchange area. Ten acres of induced commercial development are assumed.</p> <p>Within the Isle of Wight portion of the interchange area, it is likely that there will be increased pressure to change to commercial and travel-oriented land uses. This is due to the availability of water and sewer, the existing industrial park development along Route 460 (approximately 1 mile to the east), as well as the potential Norfolk Southern industrial property (approximately 2 miles to the southeast).</p> <p>Within the Suffolk portion of the interchange area, there will likely be no change to planned land uses. The City's comprehensive plan indicates that sprawl and strip development along Route 460 will not be permitted.</p>
Route 58 Bypass Suffolk	Forested and Agricultural Residential Commercial Water (Lake Meade)	<p>Water/Sewer Available</p> <p>Areas around Route 58 Bypass interchanges are designated as areas of Office Research and Development.</p> <p>Area immediately to the north of Route 460 and westward to Kings Fork, is designated for Suburban / Urban Development (with utilities)</p> <p>Due to its proximity to Lake Meade, the remaining area around the CBA 1 interchange is designated for Rural Conservation Area / Low Intensity Residential (with public water)</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Other Development - Economically Competitive <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Change in rate and scale of planned land use but no change in type of land use. Given the city's current plans for development in this area, it is likely that more intensive development will occur at the CBA 1 interchange with the Route 58 Bypass. Additional commercial services (gas station, convenience store, fast food) may develop around the interchange in response to the demands of the existing and planned Commercial / Business / Office Park developments. Twenty acres of induced commercial development are assumed.</p>

Source: Michael Baker Jr., Inc., 2005

Table 15.4-3
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 3

CBA 3 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Route 156 Prince George Co.	Forested and Agricultural Rural Residential Wetlands (Blackwater Swamp)	<p>No Water/Sewer available</p> <p>Designated Environmentally Sensitive Area (along Blackwater Swamp)</p> <p>Planned Agricultural / Open Space</p> <p>Planned Low Density Residential</p> <p>Route 156, from Route 460 north to Route 646, planned for widening to 4-lanes.</p> <p>Area at Route 156/ Route 460 intersection is within one of county's Opportunity Zones</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Minimal Development <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Change in rate and scale of planned land use but no change in type of planned land use. Likely to see increased pressure for conversion from Forested/Ag/Open Space to Low to Medium Density Residential subdivisions. 300 acres of induced residential development are assumed.</p> <p>Proximity to I-295 (3.3 miles) and Route 460 (2.3 miles), widening of Route 156, and industrial and commercial development in Petersburg and Hopewell, make this an attractive location for residential use.</p> <p>The rate and scale of residential development may increase. However, goods, services, and jobs would be easily accessible from this interchange; therefore, pressure to rezone to commercial or industrial uses would not be eminent. In addition, water and sewer are not currently available at this location.</p> <p>An Opportunity Zone (commercial and industrial development) at Route 156 and Route 460 is only 2.3 miles from the proposed interchange. This area could provide additional commercial services for this interchange area. Because trucks are prohibited on Route 629, this interchange location does not provide convenient access to the Southpoint Industrial Park to the west.</p>
Route 40 Waverly, Sussex Co.	Forested and Agricultural Rural Residential Commercial	<p>Water/sewer available</p> <p>In the vicinity of the proposed interchange, north of the town limits along the western side of Route 40, Residential development is planned. Along the eastern side of Route 40, Agricultural / Open Space is planned. Planned commercial and industrial development along Route 460 along outskirts of Town of Waverly</p> <p>Regional Industrial Park planned at old Waverly Airport (171 acres) along Route 460 near Route 602 – approximately 5.8 miles away via CBA 3</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Minimal Development - Residential Development - Light Tourist / Commercial Services (along Route 460) <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p>Light Tourist / Commercial Services (at interchange area)</p> <p>Slight to moderate change in type of land use. Waverly officials indicated that the likelihood of the area around the CBA 3 interchange being rezoned to commercial or industrial would depend on what land owners wanted to do.</p>

Table 15.4-3
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 3 (Cont'd)

CBA 3 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
Continued Route 40 Waverly, Sussex Co.			Continued from previous page Given the proximity of CBA 3 to Route 460 in Waverly (1 mile), the projected volumes on Route 40, and the availability of water and sewer, it is likely that this interchange area will experience pressure to develop Light Tourist / Commercial Services. Ten acres of induced commercial development are assumed. In addition, the area will likely experience an increase in the rate and scale of planned residential development on both the eastern and western sides of Route 40.
Route 31 Wakefield, Sussex Co.	Forested and Agricultural Residential	Water and sewer available along Route 31 Planned Residential Development north of Wakefield town limits, along both sides of Routes 31 and 617 Planned extension of water and sewer along Route 460, from Wakefield to Southampton Co. Line. Wakefield Municipal Airport approximately 1.3 miles from Route 604/460 intersection and approximately 4.5 miles from the Route 31/460 intersection	PLANNED STAGE OF DEVELOPMENT: - Minimal - Residential POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT: Light Tourist / Commercial Services (at interchange area) Slight to moderate change in type of land use. Given the proximity of CBA 3 to Route 460 in Wakefield (1.5 miles), the projected volumes on Route 31, and the availability of water and sewer, it is possible that this interchange area will experience pressure to develop Light Tourist / Commercial Services. Ten acres of induced commercial development are assumed. In addition, the area will likely experience an increase in the rate and scale of planned residential development along Route 31 in the vicinity of the CBA 3 interchange.
Route 620 Ivor, Southampton Co.	Forested and Agricultural Rural Residential	Water & Sewer along Route 460. Town of Ivor has municipal water but on septic system. Route 620 is a major commuter route to Smithfield. Planned land use around the Route 620 intersection area is Agricultural/Forested/Open/Rural Residential. The county has indicated they would consider rezoning the interchange location to its fullest potential (commercial or industrial). Such rezoning would be consistent with local plans. <i>Continued on following page</i>	PLANNED STAGE OF DEVELOPMENT: - Residential (along Route 620) POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT: Slight to moderate change in type of land use. Given the county's desire to maximize the growth potential of interchanges, the traffic volumes on Route 620, and the growing pressures from the Hampton Roads area to provide residential opportunities and supporting services, it is likely that the area around this interchange will be rezoned. This being the case, the interchange area would likely develop with Tourist / Commercial Services at the CBA 3 / Route 620 interchange. This might include a gas station or a convenience store. Ten acres of induced commercial development are assumed.

Table 15.4-3
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 3 (Cont'd)

CBA 3 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
<i>Continued</i> Route 620 Ivor, Southampton Co.		<i>Continued from previous page</i> Southampton County foresees heavy residential growth pressure from the Hampton Roads area. The county indicated that, in combination or separately, the proposed Route 460 improvement project, the proposed high-speed rail project, and the proposed "super-airport" (Eastern Virginia Airport) could dramatically affect land use and development trends in the northern portion of Southampton County.	
Route 258 Windsor, Isle of Wight Co.	Forested and Agricultural Residential	<p>Water and Sewer Available</p> <p>Roughly half of the CBA 3 / Route 258 interchange area is at within Windsor's Central Development Sewer Service District. Route 606 is the northernmost boundary for this district.</p> <p>CBA 3 / Route 258 interchange is just north of Windsor town limits.</p> <p>In Isle of Wight, the area north of Windsor is primarily planned for single family residential use. Isle of Wight adopted strict residential development guidelines in 1997. For subdivisions with over 14 lots, public water must be provided by the developer. As a result, only one subdivision has since been developed.</p> <p>Planned expansion of residential (single, multi, mobile home) within the vicinity of the interchange.</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Minimal (north of Route 606) - Residential <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Economically Competitive <p>Complete change in type of land use as well as rate and scale of development. Given the higher traffic volumes on Route 258, the distance from the interchange to the Town of Windsor (approximately 2 miles), the distance to adjacent interchanges (8 and 4 miles, respectively), and the availability of water and sewer, this interchange area meets the criteria for Economically Competitive Development. Twenty acres of induced commercial development are assumed.</p> <p>However, based on current plans and zoning, as well as the growing pressures for residential development from the Hampton Roads region, it is more likely that this interchange area will experience increasing pressure for Residential Development.</p>
Route 460 Isle of Wight Co. and Suffolk Line	Forested and Agricultural Rural Residential Commercial	<p>Water and Sewer Available</p> <p>Interchange within Windsor Development Service District to Isle of Wight / Suffolk line. This area is targeted for future growth and water and sewer facilities have been extended to accommodate growth.</p>	<p>PLANNED STAGE OF DEVELOPMENT:</p> <ul style="list-style-type: none"> - Minimal Development (in Suffolk) - Residential (Isle of Wight) <p>POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT:</p> <p><i>Continued on following page</i></p>

Table 15.4-3
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 3 (Cont'd)

CBA 3 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
<i>Continued</i> Route 460 Isle of Wight Co. and Suffolk Line		<i>Continued from previous page</i> Planned Suburban Estate use along Route 460 corridor in Isle of Wight County Planned Conservation Development to the north and south of the Route 460 corridor in Suffolk. See discussion of CBA 2 – Route 258 for more detail concerning land use within Windsor.	Continued from previous page Light Tourist / Commercial Services. Complete change in type of planned land use, as well as rate and scale of development in Isle of Wight portion of interchange area. Ten acres of induced commercial development are assumed. No change in planned land use in Suffolk portion of interchange area. Within the Isle of Wight portion of the interchange area, it is likely that there will be increased pressure to change to commercial and travel-oriented land uses. This is due to the availability of water and sewer, the existing industrial park development along Route 460 (approximately 1 mile to the east), as well as the potential Norfolk Southern industrial property (approximately 2 miles to the southeast). Therefore, within the Isle of Wight section of the interchange area, there will likely be a change in the type of land use as well as the rate and scale of development. Within the Suffolk portion of the interchange area, there will likely be no change to planned land uses. Suffolk's plans call for that portion of the city to remain a Rural Conservation Area with low density residential use and agricultural / open space. The City's comprehensive plan indicates that sprawl and strip development along Route 460 will not be permitted.
Route 58 Bypass Suffolk	Forested and Agricultural Residential Commercial Water (Lake Meade)	Water/Sewer Available The City of Suffolk's Comprehensive Plan indicates that development to the northwest of the city (including the project area) will be significantly lower in intensity, with emphasis on large lot homes with public water and septic systems. This low intensity development will occur between two urbanized areas so as to avoid a continuous mass of development along major transportation corridors. Areas around Route 58 Bypass interchanges are designated as areas of Office Research and Development. Area immediately to the north of Route 460 and westward to Kings Fork, is designated for Suburban / Urban Development (with utilities)	PLANNED STAGE OF DEVELOPMENT: - Other Development - Economically Competitive POTENTIAL CHANGE TO PLANNED STAGE OF DEVELOPMENT: Change in rate and scale of planned land use but no change in type of land use. Given the city's current plans for development in this area, it is likely that more intensive development will occur at the CBA 1 interchange with the Route 58 Bypass. Additional commercial services (gas station, convenience store, fast food) may develop around the interchange in response to the demands of the existing and planned Commercial / Business / Office Park developments. Twenty acres of induced commercial development are assumed.

Table 15.4-3
POTENTIAL INDIRECT FUTURE LAND USE CHANGES – CBA 3 (Cont'd)

CBA 3 Interchange Location	Current Land Use	Planned Future Land Use and Site Factors	Change from Planned Future Conditions based on Potential for Development
<i>Continued</i> Route 58 Bypass Suffolk		Continued from previous page Due to its proximity to Lake Meade, the remaining area around the CBA 1 interchange is designated for Rural Conservation Area / Low Intensity Residential (with public water)	

Source: Michael Baker Jr., Inc., 2005

Table 15.4-4
TRAVEL TIME SAVINGS

		Petersburg				Waverly				Wakefield				Windsor				Suffolk				Newport News				Norfolk				Richmond			
LOCATION	TIME SAVINGS (minutes)	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3	2026 NB & TSM	CB A 1	CB A 2	CB A 3
Petersburg	2000 - Original Time					27	27	27	27	37	37	37	37	59	59	59	59	73	73	73	73	102	102	102	102	104	104	104	104	38	38	38	38
	2026 - New Time					28	25	29	25	41	35	39	34	66	51	61	51	81	60	71	60	107	95	103	95	119	100	106	98	47	47	43	43
	Time Savings (%)					-4%	11%	-4%	11%	-11%	15%	5%	17%	-12%	23%	8%	23%	-11%	26%	12%	26%	-5%	11%	4%	11%	-14%	16%	11%	18%	-24%	0%	9%	9%
Waverly	2000 - Original Time	27	27	27	27					10	10	10	10	33	33	33	33	46	46	46	46	77	77	77	77	77	77	77	77	64	64	64	64
	2026 - New Time	29	25	30	25					12	10	11	10	37	30	33	28	52	40	42	37	78	73	75	72	90	79	77	75	74	69	72	68
	Time Savings (%)	-7%	14%	-3%	14%					-20%	17%	8%	17%	-12%	19%	11%	24%	-13%	23%	19%	29%	-1%	6%	4%	8%	-17%	12%	14%	17%	-16%	7%	3%	8%
Wakefield	2000 - Original Time	37	37	37	37	10	10	10	10					22	22	22	22	36	36	36	36	67	67	67	67	67	67	67	67	75	75	75	75
	2026 - New Time	41	35	40	34	12	10	11	10					25	21	23	21	40	32	32	30	66	63	65	63	78	72	67	69	85	79	82	77
	Time Savings (%)	11%	15%	2%	17%	-20%	17%	8%	17%					-14%	16%	8%	16%	-11%	20%	20%	25%	1%	5%	2%	5%	-16%	8%	14%	12%	-13%	7%	4%	9%
Windsor	2000 - Original Time	60	60	60	60	33	33	33	33	22	22	22	22					14	14	14	14	44	44	44	44	45	45	45	45	97	97	97	97
	2026 - New Time	66	51	62	52	37	30	33	28	25	21	23	21					16	11	11	11	45	44	44	44	53	50	45	50	110	95	105	94
	Time Savings (%)	10%	23%	6%	21%	-12%	19%	11%	24%	-14%	16%	8%	16%					-14%	31%	31%	31%	-2%	2%	2%	2%	-18%	6%	15%	6%	-13%	14%	5%	15%
Suffolk	2000 - Original Time	73	73	73	73	46	46	46	46	36	36	36	36	14	14	14	14					33	33	33	33	31	31	31	31	111	111	111	111
	2026 - New Time	81	60	71	60	52	40	43	37	40	32	32	30	16	11	11	11					37	38	38	38	38	40	35	39	126	104	114	103
	Time Savings (%)	11%	26%	12%	26%	-13%	23%	17%	29%	-11%	20%	20%	25%	-14%	31%	31%	31%					-12%	-3%	-3%	-3%	-23%	-5%	8%	-3%	-14%	17%	10%	18%
Newport News	2000 - Original Time	102	102	102	102	77	77	77	77	67	67	67	67	45	45	45	45	33	33	33	33					26	26	26	26	88	88	88	88
	2026 - New Time	107	95	104	95	78	73	75	72	67	63	65	64	45	45	44	44	38	38	38	37					26	27	27	27	98	98	97	97
	Time Savings (%)	-5%	11%	3%	11%	-1%	6%	4%	8%	0%	6%	3%	4%	0%	0%	2%	2%	-15%	0%	0%	3%					0%	-4%	-4%	-4%	-11%	0%	1%	1%
Norfolk	2000 - Original Time	105	105	105	105	78	78	78	78	68	68	68	68	45	45	45	45	32	32	32	32	26	26	26	26					108	108	108	108
	2026 - New Time	116	96	110	97	87	76	81	74	75	68	71	68	50	47	49	48	34	36	38	37	26	26	26	26					117	118	117	116
	Time Savings (%)	10%	17%	5%	16%	-12%	13%	7%	15%	-10%	9%	5%	9%	-11%	6%	2%	4%	-6%	-6%	12%	-9%	0%	0%	0%	0%					-8%	-1%	0%	1%
Richmond	2000 - Original Time	40	40	40	40	65	65	65	65	75	75	75	75	97	97	97	97	111	111	111	111	87	87	87	87	106	106	106	106				
	2026 - New Time	48	48	44	44	72	68	71	67	84	78	81	77	109	94	103	94	125	104	112	102	96	97	97	96	116	116	116	115				
	Time Savings (%)	20%	0%	8%	8%	-11%	6%	1%	7%	-12%	7%	4%	8%	-12%	14%	6%	14%	-13%	17%	10%	18%	-10%	-1%	-1%	0%	-9%	0%	0%	1%				

Source: Michael Baker Jr., Inc., 2000

REFERENCES

- Anderson, Connie and Otto, David. *The Economic Impact of Rural Highway Bypasses: Iowa and Minnesota Case Studies*. Ames Iowa. Office of Advanced Planning. Iowa Department of Transportation. 1991.
- Anderson, Michael D. and Souleyrette, Reginald R. *Quick-Response Bypass Forecasting for Small Urban Communities Using an Economic Gravity Model for External Trip Analysis*. Center for Transportation Research and Education. 1998 Transportation Conference Proceedings, Ames, Iowa. 1998.
- Blackburn, Sabrina and Clay, James W. University of North Carolina at Charlotte. *Impacts of highway bypasses on Community Businesses*. North Carolina Division of Community Assistance and the I-40 Steering Committee, November 1991.
- Buffington, Jesse L; Womack, Katie; and Iliff, Sally. *Synthesis of Information Related to Highway Problems, Effects of Highway Bypasses on Rural Communities and Small Urban Areas*. NCHRP Project 20-5, Research Results Digest No. 210. TRB. May 1996.
- Buress, David. *Impacts of Highway Bypasses on Kansas Towns*. University of Kansas for Kansas Department of Transportation. 1996.
- Center for Watershed Protection, 2003
- City of Suffolk, Virginia. "2018 Comprehensive Plan. Volume One: The Plan". March 25, 1998.
- City of Suffolk, Virginia. Interview with Scott Mills, Robert Goumas, and Cynthia Taylor on July 7, 2004.
- City of Suffolk, Virginia – Planning Department. The Comprehensive Plan for 2018: City of Suffolk, Virginia. Volume 1: The Plan. Adopted March 25, 1998. Page 43.
- Comer, Dr. Jonathan C and Finchum, Dr. G. Allen, II. Oklahoma State University - Department of Geography. *Analyzing Impacts of Highway Construction Activities in Oklahoma: Phase I – Socioeconomic Impacts Final Report*. Oklahoma Transportation Center Project ID #2160-02. November 8, 2002.
- Comer, Dr. Jonathan C; Finchum, Dr. G. Allen, II; and Coleman, Amanda K. Oklahoma State University - Department of Geography. *A Methodology Using Geographic Information Systems to Evaluate Socioeconomic Data Concerning Impacts of Highway Bypasses in Oklahoma*. Proc. Okla. Acad. Sci. 80:79-89(2000). October 3, 2000.
- Connor, George, Virginia Department of Rail and Public Transit, e-mail communication on 12/2/04.
- Comprehensive Plan - Isle of Wight County, Virginia* by the Isle of Wight Planning Commission, with the assistance of Redman/Johnston Associates, Ltd. Adopted June 21, 2001.
- Council on Environmental Quality (CEQ). January 1997. Considering Cumulative Effects Under the National Environmental Policy Act.
- County of Prince George, Virginia. "Prince George County Comprehensive Plan Update". May 1999.
- County of Prince George, Virginia. Interview with Bill Bailey, Leon Hughes, Jerry Skalsky, and Morgan Allen, July 14, 2004.
- County of Sussex, Virginia. "1997 Comprehensive Plan Update". November 1997.
- County of Sussex, Virginia. Interviews with Mary Jones, Andre Greene, and William Turner on July 14, 2004.
- County of Surry, Virginia. "Land Development Plan". November 1974.
- County of Surry, Virginia. Interview with Tyrone Franklin on July 7, 2004
- County of Southampton, Virginia. "Vision2020: 2000 Comprehensive Plan Update". August 2001.

- County of Southampton, Virginia. Interview with Waverly Coggsdale
- County of Isle of Wight, Virginia. "Comprehensive Plan". June 2001
- County of Isle of Wight, Virginia. Interview with Patrick Small and John Hartley, July 12, 2004.
- County of Isle of Wight, Virginia, with assistance from Redman/Johnston Associates, Ltd. Comprehensive Plan: Isle of Wight County, Virginia. June 2001.
- Dalton, Linda, et al. The Practice of Local Government Planning. International City/County Management Association. Third Edition. 2000.
- Economic Development Research Group, Inc. and Cambridge Systematics, Inc. for Federal Highway Administration. *Using Empirical Information to Measure the Economic Impact of Highway Improvements. Volume 1: Review of Literature, Data Sources, and Information Needs. Volume 2: Guidelines for Data Collection and Analysis.* March 2001. <http://www.edrgroup.com/hwy-impact.html>. Accessed May 6, 2004.
- Federal Highway Administration (FHWA). September 1996. *Community Impact Assessment A Quick Reference for Transportation.* 1992. Position Paper: Secondary and Cumulative Impact Assessment in the Highway Project Development Process.
- FHWA. Contributors – Leong, Dennis; Lichtman, Liat; Marcos, Franklin; and Michelson, Kristi. *Economic and Land Use Impacts Study of State Trunk Highway 29. Phase 1 – Chippewa Falls to Abbotsford, Wisconsin.* December 2002 (rev. July 2003). <http://www.fhwa.dot.gov/planning/econdev/wis29.htm>. Accessed April 22, 2004.
- FHWA. Environmental Guidebook – Environment and Planning – FHWA. Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process. <http://environment.fhwa.dot.gov/guidebook/qaimpact.htm>. Accessed October 21, 2004.
- FHWA, Office of Highway Information Management, Highway Statistics Series 1995, Washington, D.C.: FHWA, USDOT, 1996
- Forkenbrock, D. and Weisbrod, G. 2001. *Guidebook for Assessing the Social and Economic Effects of Transportation Projects.* NCHRP Report 456
- Handy, S.L; Jarrett, J.; and Vanka, S. *Economic Effects of Highway Relief Routes on Small- and Medium-Size Communities.* Center for Transportation Research – Bureau of Engineering Research, The University of Texas at Austin. Research Report Number 0-1843-4. March 2001.
- Hartgen, David T.; O'Callaghan, Janet E.; Walcott, Wayne A.; and Opgenorth, Jane. *Growth at Rural Interchanges: What, Where, Why.* In *Transportation Research Record*, No. 1359 – Planning and Administration: Economics, Finance, and Administration. National Academy Press. Washington, D.C. 1992.
- Kentucky Transportation Center - University of Kentucky. *The Impact of a New Bypass on the Local Economy and Quality of Life.* Research Report KTC-01-10/SPR219-00-21.
- Kozel, Scott M at http://www.roadstothefuture.com/I64_VA_Desc.html. Accessed 11/01/04.
- Kozel, Scott M. at http://www.roadstothefuture.com/I664_History.html#Construction. Accessed 11/01/04.
- Land Development Plan: Surry County, Virginia by the Surry County Planning Commission and the Crater Planning District Commission. Adopted November 21, 1974.
- Leong, Dennis (Wisconsin Department of Transportation) and Weisbrod, Glen (Economic Development Research Group). *Summary of Highway Bypass Studies*, excerpted from the report *Economic Impact Analysis: St. Croix River Crossing – Minnesota Department of Transportation and the Wisconsin Department of Transportation.* July 1999. Economic Development Research Group. December 2000.

- Lliff, Sally D.; Buffington, Dr. Jesse; and Womack, Katie. *Effects of Highway Bypasses on Rural Communities and Small Urban Areas*. National Cooperative Highway Research Program. Research Results Digest Number 210. May 1996.
- Louis Berger & Associates. 1998. *Guidance for Estimating the Indirect Effects of Proposed Transportation Projects*. NCHRP Report 403.
- The Nature Conservancy at <http://nature.org/wherewework/northamerica/states/virginia/preserves/art4982.html>. Accessed 11/01/04
- Oregon Department of Transportation Planning Section. *Bypass Study 2002*. <http://www.odot.state.or.us/tdb/planning/highway/bypass/home.htm>. Accessed May 4, 2004.
- Parsons Brinckerhoff Quade and Douglas, Inc. 1999.. *Land Use Impacts of Transportation: A Guidebook*. NCHRP Report 423A. Transportation Research Board. National Academy Press. Washington, D.C. 1999.
- Prince George County Comprehensive Plan Update*, by Prince George County Department of Planning. Adopted May 25, 1999.
- Rogers, Cynthia L. and Marshment, Richard. *Measuring Highway Bypass Impacts on Small Town Business Districts*. University of Oklahoma. October 3, 2000.
- Smith, Lamar, Federal Highway Administration. *Indirect and Cumulative Impact Analysis in the NEPA Process - PowerPoint Presentation*. TXDOT Environmental Conference Austin Texas on November 30, 2004.
- Srinivasan, Sivaramakrishnan and Kockleman, Kara Maria. *The Impacts of Bypasses on Small and Medium-Sized Communities: An Econometric Analysis*. Journal of Transportation Statistics, Volume 5, No. 1. 2002.
- Sussex County. *1997 Comprehensive Plan Update for the County of Sussex, Virginia*, by William C. Overman Associates, P.C. Board of Supervisors Adoption on November 20, 1997.
- Texas Transportation Institute. *Effects of Highway Bypasses on Rural Communities and Small Urban Areas*. AASHTO. 1995.
- Town of Waverly, Virginia. Interview with Susan Irving, July 8, 2004.
- Town of Wakefield, Virginia. Interview with Wayne Birdsong, July 6, 2004.
- Town of Windsor, Virginia. "Comprehensive Plan". June 2003.
- Town of Windsor, Virginia. Interview with James Randolph and Kurt Falkenstein, July 8, 2004.
- The Comprehensive Plan for 2018 – City of Suffolk, Virginia* by City of Suffolk Department of Planning with assistance from LDR International, Inc., in association with Demer & Associates, Kellerco; Frielich, Leitner & Carlisle; and UDA Architects. Adopted March 25, 1998.
- Town of Windsor, Virginia: Comprehensive Plan (2003 – 2023)* by the Town of Windsor Planning Commission with assistance by K. W. Poore & Associates, Inc. Adopted June 2003.
- U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population and Housing.
- U.S. Department of Labor, Bureau of Labor Statistics www.bls.gov Accessed April 27, 2005.
- U.S. Environmental Protection Agency (USEPA). May 1999. *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*.
- Virginia Department of Game and Inland Fisheries. Virginia Fish and Wildlife Information Service (VAFWIS). www.vafwis.org. Accessed February, 2005.
- Virginia Department of Transportation. *TransAmerica Corridor Feasibility Study: Beckley, West Virginia to Hampton Roads, Virginia – Final Report*. May 1999.



Vision 2020: County of Southampton, Virginia – 2000 Comprehensive Plan Update by LandMark Design Group. August 27, 2001.

Weisbrod, Glen. *Highway Bypasses of Small Communities: Review of Findings on Their Economic Impacts*. Economic Development Research Group, Inc. November 2001. <http://www.danc.org/ncts/edr.htm>. Accessed 5/23/04.

Wells, Steve and Farnworth, Todd. Wilbur Smith Associates. *Economic Impacts of Highway Bypasses on Small Communities – A Review*. Economic Development Research Group. Boston, MA. November 2001. <http://www.danc.org/ncts/wsa.htm>. Accessed April 22, 2004.